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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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The Teacher's Health.

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DEAFNESS.

THOSE in whom the faculty is completely annihilated cannot be helped unless the organ of sight is capable of assisting. The pathological condition of the nerve of hearing prohibits the thought of recovery. The most comfortable course for the sufferer is to acquire the capacity of understanding the language of the dumb, and to have an interpreter at hand who can talk with his fingers. The totally deaf person sometimes obtains great help by lip language, but it is uncertain and too intricate to be described here. The best aid is to be obtained by means of the dumb alphabet, and if there is total deafness it is best to converse by writing on the slate, or with the fingers, and not to attempt to make the deaf person hear. The second class, viz., those in whom articulate sounds are heard with difficulty, and who yet may be assisted by artificial means, are the most numerous, and also the most troublesome class. Some will resent the idea that they are deaf, and insist upon people speaking up, accusing them of lowering their voice on purpose; or they become suspicious, and believe that those about them are talking low because they don't want the deaf person to hear what is being said. They are often also very inquisitive, wishing to have everything explained to them even to the smallest detail, whether it be important or not. There is a curious difference between the mental resignation which so often attends upon the nearly and the totally blind, and the irritability and suspiciousness of the partially deaf. We must suppose from the frequency with which the difference is observed that the roots of the auditory nerve become affected by the condition which gives rise to the deafness, and that this irritates the neighbouring nerve cells and conveys the impulse to some part of the brain connected with the organ of thought, and thus produces the mental state which gives rise to irritability and suspicion. These cases are sometimes much helped by various forms of ear-trumpets; none are better adapted to collect sound than the human ear, and it is simply by enlarging its area that we obtain help. The object of the ear-trumpet is to collect vibrations from one direction and to exclude others. If the tympanum is pervious and the middle ear damaged, some assistance may be obtained by its use; the simplest form of trumpet with a well-expanded mouth is the best. There are some very expensive kinds, which are supposed to be of great service, and so they are to their sellers; they fill the pockets of their designers, but a half-crown lacquered tin instrument will be as effectual as one for which several guineas has been paid. Those small instruments which are sometimes advertised as fitting under the cap and into the cavity of the ear, and are thus invisible, are more likely to be injurious than beneficial. I advise all deaf persons to keep their money in their pockets rather than invest it in such useless contrivances. Conversation tubes are such as have a comfortable ear-piece with a long elastic tube, terminating in a small trumpet-shaped opening. This is held in the hand of the speaker, who speaks into it, and the listener is thus able to hear what is said by that individual, even if he be on the other side of the room, whilst there may be a general hum of conversation all over the room. These tubes correspond in effect to the speaking-trumpet which is sometimes affixed near to the doctor's night-bell, and is as often misused for the purpose of practical joking as for actual use.

The third-class, viz., those in whom there is an alteration or diminution of hearing for want of precision, are very often cases which cause much trouble to the teacher, as they are common to the young of both sexes. Boys and girls are inattentive, and such inattention causes a want of precision, and they misunderstand the purport of the observations addressed to them. The boy begins to say, 'What did you say, sir?' before the master has finished his sentence; he has lost the first part from inattention, and in trying to catch it he loses the second, which, if he had listened for it, would probably have told him all that was necessary. In these cases there is usually some thickening of membrane in the Eustachian tube which causes delay, so that the condition of the middle ear is altered. Sounds reach the tympanum on the one side before the middle ear is ready to transmit them, or the successive sounds are mixed up and confused when

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they reach the auditory nerve itself, because the muscles are late in responding to the vibration, and do not respond until too late. It is important that young people should be broken of the habit of interrupting by asking, 'What did you say, sir?' The sentence of the speaker should be completed before enquiry is made as to what has been said. Inattention has much to do with the production of this class of disease, although in some it may arise from causes beyond the control of the individual. The muscles of the ear, as well as those of the eye, or those of the fingers, can only be brought to perfection by exercise and studied use, and if they are not brought into use, as is the case when a person is listening inattentively, they will lose their power of precision and be unable to appreciate the delicacy of sound, which is pretty sure to come if it be properly educated. If two persons are compared of equal health and strength, one of whom has been brought to distinguish the difference of sounds, and the divisions which can be made in them by the study of music, while the other has never paid any attention to music or its charms, it will be seen that the hearing of the musician is much more acute, delicate, and exact than that of the unobservant listener. Whenever there is a diminution of hearing from want of precision, the subject of it should learn music at once, and so bring into play the muscles which are defective in their action, for it is certain that musicians, as a rule, are much less liable to suffer from deafness than any other class of persons.

The prevention of deafness is the best method which can be adopted for keeping the ear in a healthy state. It is specially necessary if there should be any hereditary tendency to deafness. Some families have this tendency. Preventive measures are of several kinds. The ear is a very delicate organ, and must be protected from cold air blowing exclusively upon the auricle; this applies to those who are subject to ear-ache, or to discharges from the meatus. It is unwise to be poking the ear for the purpose of dislodging any material which may be thought to have invaded the outer passage. Beyond the use of warm douche, it is dangerous to do anything to the internal part of the ear without skilled advice. Attention to the general health is very necessary. Those who have a gouty or rheumatic habit will do well to recollect that the ear is especially liable to be invaded by those diseases, and if there is deafness coming on from these causes it is probable that a restricted diet for the gouty tendency and warmer clothing for the rheumatic may be among the preventive measures which should be taken.

Keeping in mind what has been said as to the alteration and diminution of hearing which comes on from want of precision, it is important for those who observe such a condition arising in a young person to take measures to arrest its continuance. If it is found that there is no evidence of change in structure to account for the deafness, the child should be made to practise as to the distance at which sounds can be heard, both as to character of tone and quality of pitch. If there are several children in a large school who can be classed together, they should be drilled, and made to listen for the tick of a watch or tone of a tuning-fork, and to try and hear it from a greater distance on each occasion. It will be found that education will develop precision and diminish the chance of permanent deafness arising from some of the minute muscles of the ear becoming paralysed or undeveloped for want of use. They are voluntary muscles, and if not used will certainly lose precision and power, just as any other set of muscles must do.

Finally, the teacher who is growing deaf will wisely determine the cause of the deafness, and take measures to remove that cause, rather than treat the result. If the general health is attended to in a proper manner, and there are no local conditions giving rise to it, there is no reason in the abstract why Deafness should be established, and therefore no reason why the teacher should become incapacitated from his duty by that defect alone.

THE THROAT AND VOICE.

As deafness is often associated with certain changes in the condition of the throat, it will now be convenient to take into consideration the conditions which interfere with the perfection of the voice, and the maladies which specially affect the throat. Very few persons pass through this life without having at one time or another some complaint of which hoarseness and sore throat are parts, or even the whole of the malady. The major portion of the causes which set up cough are in the throat. The constant cough which disturbs every school in changeable weather is generally due to some relaxation of throat membrane. The throat may be irritated by an atmosphere which is too dry, as well as by one which is loaded with particles of foreign matter, as happens in some factories. Some persons have a distinct proclivity to sore throat, either from hereditary tendency or in consequence of a local weakness which has been the sequence of a preceding attack of scarlatina or diphtheria, or the result of some syphilitic affection. The custom also of smoking must have an effect upon the mucous membrane of the throat, rendering it more susceptible of changes as to temperature and moisture. Breathing an atmosphere laden with tobacco-smoke, such as is found in the sitting-rooms of public-houses, in low concert-rooms, and in other similar places of assembly, is very likely to set up a liability to relaxed throat. The long-stemmed pipe—the old 'churchwarden,' as it is sometimes called—is much safer, because the smoke is cooler than that which proceeds from the short cigar. A long cigar, only half of which is consumed, is the next best way to use tobacco; short pipes are not safe, and cigarettes are the most injurious of all. The great tobacco-smoker is revealed by an inspection of the throat, even if he is not known by his sallow face. Sudden exposure to a raw cold air after inhaling a hot atmosphere, such as happens when persons come out of a badly-ventilated building crowded with persons, and pass into a colder region, produces relaxed throat. Teachers who will not ventilate their schoolrooms properly, and clergymen who preach in hot churches and chapels, are especially liable to this condition, by which a state called the 'clergyman's throat' is easily produced. Persons who have been sitting near a large fire, so as to get the pores of a portion of the body thoroughly relaxed, and who then pass into the outer air without making any difference in the character of clothing, suffer in a similar manner. Over-strained muscles, such as are produced by long-continued loud talking, protracted reading at a high pitch, screaming and talking for a long time to a deaf person, are all customs which produce a condition similar to a 'clergyman's throat,' in

which muscle as well as membrane is put out of gear, and when it is so accompanied it requires a long time to restore the tension of the muscle and recover the voice again.

The use of iced drinks assists to promote relaxed throats, and so does the use of drinks which are excessively hot, whether from the temperature being too high, or from the presence of spices or peppers; the excessive use of intoxicating liquors will keep a throat in a relaxed and uncomfortable state, and habits of intemperance will prevent such a throat from recovering its tone. The man (or woman) with a fine voice, the cultivated vocalist, the charming solo singer, risks the loss of his faculty by deadening the delicacy of his laryngeal nerves by the continued use of intoxicating liquors.

Whilst, however, we must be careful to avoid certain kinds of exposure, it is important to recollect that too great care is also injurious. The sailor does not cover up his throat under any circumstances, and is not troubled with sore throat. The clergyman or the opera singer who muffles up the throat with wraps of all kinds, is especially liable to such a misfortune. The inference to be drawn from this contrast is a decided and an important one. It is not advisable to muffle the throat after exertion when the body is warmed, but it is advisable to protect the warmed body, and, above all, to avoid the direct application of cold air to the larynx itself.

(To be continued.)

—o—

Friedrich Fröbel.

BY HIS PUPIL, HERR HEINRICH HOFFMANN, KINDERGARTNER, ALTONA,

President of the Fröbel-Verein.

III.

A CONSCIENTIOUS, well-meaning father, deploring the spiritual death of a son, who, through misunderstanding and adverse circumstances, had been alienated from his affection, is mercifully led to see his error, and allowed to rejoice over the unhoped-for discovery that his son is not thus dead, but still fully merits a father's love and the high esteem of which his uncle had declared him to be worthy. What a triumph that young and all but despairing soul must have felt when he at last recovered his father's loving confidence, and was permitted to cheer his closing days, to be indeed his solace, at a season when he stood most in need of such comfort.

That last period of more than a year must have been an unspeakable blessing to both father and son. In February, 1802, Friedrich received the last fervent blessings of his father, and then stood alone in the world! Yes, alone! But the sad troubles which he had endured were effaced in the precious consciousness, that his dying father had blessed him, and that he now was one with him for evermore.

With renewed energy and enthusiastic hopes he returned to what he still considered his calling. He was now twenty years of age. He repaired to the neighbourhood of Bamberg, and engaged himself as an actuary in a 'forest office.' His duties were light. The country was full of scenery of an exquisite beauty. He found ample leisure to pursue his studies of Nature. The extensive library of his chief afforded him welcome opportunities for enriching his mind. This period of his life was thus productive of great benefit.

In the hope of obtaining a government appointment in Bamberg, he resigned his office in 1803; but having failed in his object, he engaged himself as private secretary to President von Dewitz, in Mecklenburg Strelitz.

The society in which he now moved was most pleasant, and his friendly intercourse with men of sterling worth and superior education would have made him very happy, but for the disquieting consciousness that his present situation was only a makeshift, a kind of temporary shelter. He felt that he was not progressing towards his goal. His purpose was to reach the summit of agricultural science, and he could not bear to lose sight of his ultimate aim for a moment. On the other hand he feared to appear to any in an unfavourable light, more especially to his beloved brother Christoph, the clergyman, whose good opinion he was most anxious to secure. In this dilemma it was a comfort to him to resume his mathematical studies, and the deeper he became absorbed in them, the more they seemed to him to assume one practical form—architecture! In his innermost soul there certainly was a still higher aim, one to which all other things were but stepping-stones, the vital question of his whole existence: 'How can I benefit my fellow-men? How can I raise them to the true dignity of manhood?' His simple answer was, 'By cultivating to the utmost the powers God has given me, in whatever direction they may lie.'

Architecture seemed to him the means of attaining this high aim; and to this science he decided to devote himself without reserve. During his sojourn in Bamberg he had formed an intimate friendship with a young man, whose views and opinions had great weight with him; to whom, in fact, he looked as to an oracle. This gentleman counselled him to continue the study of architecture, and suggested Frankfort as a place most favourable for its pursuit. But a journey to Frankfort—one of great expense in those days—and the stay there were sure to require more money than he could afford; so, with a faint heart, he wrote to his brother Christoph for advice and assistance. The gist of the letter was: 'Only in striving after the perfection of my inner nature can I find the aim and purpose of my life.'

The answer came, but so nervous did he feel about its contents, that for several days he could not muster courage to open it. For although his brother's willingness did not admit of the shadow of a doubt, his ability to assist him was very doubtful indeed. The contents moved him to tears; there were manifested, both in and between the lines, kind sympathy and deep brotherly love and care; but what touched him to the quick was that his great benefactor, his dear uncle Hoffmann, had been called home. So overwhelmed was he with grief, that he could take but little interest in the statement that his fatherly friend had left him a legacy. Never could such assistance have been more opportune. Providence indeed watched over him with wonderful kindness, and smoothed his path to a grand and noble calling, of which he as yet was all but unconscious. I say advisedly, "all but!" for a dim presentiment would occasionally dawn upon him. Now and then expressions and sentiments would escape

him, which clearly pointed to a future that was to him a mystery. On a visit to Hokermark, he wrote in the album of a dear friend: 'May Heaven soon give *you* a comfortable home and a loving wife; as to myself, may it toss me restlessly about, leaving me only sufficient leisure to enable me to understand correctly my relation to my inner being and to the world. *You* shall provide men with their daily bread, but *my whole aim shall be to recover men back to themselves.*'

In May, 1805, whilst on his journey to Frankfort, he visited his beloved brother Christoph. Those were days of a happiness so pure, so serene, that he cherished their memory all his life. His brother took the liveliest interest in his plans, and exhorted him always to follow faithfully the voice within him; and wrote in his album the following words, which became engraven on his mind, and were adopted as the motto of his life: 'Man's destiny is to struggle through difficulties until his aim is attained. Act as a man, my dear brother, firmly and resolutely; combat every obstacle that may bar thy way, and be sure thou shalt be successful.' In Frankfort he was joyfully received by the friend on whose advice he had acted so confidingly. To find a situation in some architect's office seemed to them the first thing necessary. Little did he know what sort of office would soon realise his ardent longings for peace with God and man! Meanwhile his friend introduced him to his own circle of acquaintances. Among these there were several young teachers, assistants at the 'model school' of Director Gruner. Their conversations kindled new ideas; his attention was more and more directed to questions of education. One evening Fröbel was invited to the head-master's house. In his usual animated manner he expounded his own original ideas on education, such has had been evolved by his own motley career, by his unremitting studies on his own 'inner world,' and by the world around him, and besides gave an unvarnished sketch of his life, his aspirations, his disappointments, and his hopes. Gruner listened with deep interest, and with quick perception unriddled the enigma that had so long kept Fröbel in bondage. 'Oh,' said he, 'give up architecture; that is not your calling; turn to education. Teaching is to be the essence of your life, and if you will join us in our school, there is a place open for you, and welcome!'

(To be continued.)

—o—

Julius Cæsar.

ACT II.

NOTES ON SCENE I.—*(continued.)*

138. *Several.*—Individual.

139. *Do.*—Pleonastic.

141. The practical man recalls them from these interesting metaphysical speculations to business.

142. *Strong.*—Adjective for adverb. *Other examples.*

144. Cicero was now sixty-two years of age. He died next year.

145. Note the scanning of the last word.

148. *Youths.*—An unusual plural. Compare it with 'behaviours' in l. 2, 42 of this play. *No whit* = nought, not anything.

150. *Break with.*—Break the matter to.

151. A shrewd estimate of Cicero. It is remarkable how, in a phrase, Shakspere gives the key to the character of the orator. Merivale, in his 'History of the Romans under the Empire,' enlarges upon this idea.

153. Note how Casca ever follows the lead of Cassius.

154. Decius thinks for himself, and with a cold and bitter calculation of all danger and of all possibilities.

157. *Of.*—In.

158. *Shrewd.*—Originally 'bad.' To 'shrewe' was to wish evil. The noun to-day = a scold; the adjective passing through the stage of censorious now means sharp. *Contriver.*—A rare noun from a common verb. 'As You Like It' i. 1, 151. *Means.*—Opportunities and abilities.

162. The theorist again mars the efficiency of the practical man. Cassius is right, as after events prove. 'If 'twere well when 'twere done, then 'twere well 'twere done' completely.

164. *Envy.*—In the strong sense of hatred. Coriolanus iii. 3, 3.

166. *Sacrificers.*—To him the killing of his friend is a sacred duty.

169. *Come by.*—Acquire. Antonio, at the opening of the 'Merchant of Venice,' in his prophetic depression, cannot tell how he 'caught it, found it, or came by it' (i. 1, 3).

176. *Servants.*—Our unwilling hands that must do this deed.

178. *Envious.*—The result of hate.

180. *Purgers.*—Purging the state of tyranny.

184. *Ingrafted love.*—Perhaps Cassius means that the love of Antony for Cæsar is in some measure foreign to his lighter nature.

194. *No.*—Commonly in Shakspere's time, and occasionally to-day used inaccurately for 'not.'

195. *Superstitious.*—Julius Cæsar affected to depise the superstitions of his age. Yet there was more of affectation than reality in his contempt.

196. *Main.*—Strong.

197. *Fantasies.* — Imaginations. *Ceremonies.* — Religious observances and auspices, as flights of birds and entrails of beasts.

198. *Apparent prodigies.*—Prodigies that have appeared.

199. *Unaccustom'd.*—Unwonted, unusual.

200. *Augurers.*—Augurs. Officers who foretold future events. Under Romulus, their founder, 3; under Servius Tullius, 4; increased by the Tribunes to 9; under Sylla, 15.

204. *Unicorns.*—Fabled animals even to the ancients. Pliny gravely states that one had never been taken alive. *Betray'd with trees.*—The lion, attacked by the unicorn, according to Topsell, always runs behind a tree, and the infuriated hoofed animal, running full tilt, becomes fixed by his solitary horn into the tree.

205. *Bears with glasses.*—Leopards (and why not bears?) are said to have been caught by aid of looking-glasses, their rapt attention upon their own image enabling the hunter to enmesh them unawares. *Elephants with holes.*—Pits were dug to entrap elephants. Pliny has it that if one were thus caught, his fellows gathered together to his aid, and thus were easily captured also.

206. *Toils.*—Snares. The origin of this 'toil' is *tela*=a web, through the French *toile*. That of 'toil' in the sense of labour is tilian=to labour. Compare Zielen (German).

210. *Bent.*—Direction, inclination. 'They fool me to the top of my bent,' says Hamlet (III. ii. 385).

211. *There.*—Cæsar's house. See the next scene.

213. *Uttermost.*—A word worth taking to pieces. 'Out,' the adverb, gives us a comparative form, 'utter,' and this used as a positive has a comparative (rarely) and a superlative, as in this case, built out of it. The 'ost' is the ending 'est,' and the 'm' is really inserted for euphony.

215. *Caius Ligarius.*—This leads up to the effective close of this scene (line 310). *Bear hard.*—*Ægre ferre* is the Latin equivalent.

216. *Rated.*—Scolded. In reality Ligarius was dismissed from service by Cæsar for his adherence to the cause of Pompey.

217. *None have.*—For the more inelegant, but more accurate, 'none has.'

218. *By him.*—Past his house.

221. *We'll leave you.*—We may safely leave you, having won you to us.

225. *Put on.*—Denote. Compare this line with the

> 'However he puts on this tardy form'

when Cassius speaks of Casca (I. ii. 297), and with the same speaker's 'You put on fear' to Casca (I. iii. 68).

226. *Bear it.*—Behave. Compare the French 'se porter'

227. *Formal.*—A wise adjective here. Nothing informal, unusual, abnormal must appear in them.

229. *Boy!*—These cloaked conspirators gone, he calls for the child again. Had his cry awakened Lucius, I think his master would have sought solace in music as he does on the last night of his life (IV. iii. 254).

230. *Honey-heavy dew.*—That strange being, the commentator, has suggested that this should read 'heavy honey-dew.' Is it necessary to point out that almost the whole of the rich meaning in the phrase vanishes with such a transposition? To the boy the dew of slumber is heavy with a lethargic sweetness.

232. *In the brains.*—The ache and pain of thinking comes out in this far more than if he had used the impalpable 'mind' instead of 'brains.'

233. *Brutus—my lord.*—Her first cry does not move him from his reverie. In this scene you will note how shrewdly she turns his words against himself.

237. *Neither.*—A double negative. It is important to remember that although Shakespeare uses these double negatives again and again, and never in the affirmative sense attaching to them to-day, yet the fact that two negatives make an affirmative was known to him. In 'Twelfth Night' (V. i. 22) the clown says, 'If your four negatives make your two affirmatives.' Cancel the twos and you have the modern rule.

238. *Stole.*—For stolen. *Find other cases.*

240. *Arms across.*—Arms folded, as in thought.

243. *Scratch'd your head.*—An action as undramatic as undignified. One of the very rare cases in which Shakespeare lapses into a vulgarism.

246. *Wafture.*—Wave. A hybrid word, *i.e.*, one compounded of parts from two different languages. 'Wave' is Teutonic. 'Ura' is a classical ending, and is accurately used in such words as 'rapture' (from *rapio*) or 'fissure' (from *findo*). *Find other cases of hybrid words.*

247. *So I did.*—With true woman's wisdom, she knows how to seem to let him have his way whilst in the event she will have hers. With dramatic wisdom Shakspere gives us this scene in her vivid word-painting, not actually on the stage. The same wisdom exercised in a different manner prompts him to close this scene only with the promise of Brutus to reveal all, not with the actual revelation (305, 306).

250. *Humour.*—Melancholy. In the Elizabethan time, after the material fashion of those days, mental phenomena were due to the presence of actual fluids or humors in the body; the very word 'melancholy' is an instance. μελας (*melas*)=black, χολη (*chole*)=bile. Compare this use of the word with that in line 262.

251. *His.*—The neuter *his* is common in Old English as late as the 17th century.

253. *Shape.*—Of body.

254. *Condition.*—Of mind.

257. He tells lies badly.

259. *Come by it.*—Attain it. Antonio in the 'Merchant of Venice,' I. i. 3, speaking of his melancholy says,

> 'But how I caught it, found it, or came by it,
> I am to learn.'

260. *Go to bed.*—This is scarcely argument.

261. *Physical.*—Medicinal.

262. *Unbraced.*—With garments loosened, that ease of body may, perhaps, beget ease of mind. Notice how Hamlet, also suffering from 'a mind diseased,' is also dishevelled as to apparel. Ophelia describes him (II. i. 78):

> 'With his doublet all unbraced,
> No hat upon his head: his stockings foul'd,
> Ungartered and down—gyved to his ancle.'

Notice in this play that the first mention of his clothes' condition comes from the wife. *Humours.*—Moistures.

263. *Dank.*—Damp.

266. *Rheumy.*—Rheum, rheumy, and originally rheumatism, had all to do with coughs and colds generally. *Unpurged.*—The sunlight not having as yet purified it.

268. *Sick offence.*—An offensive or troublesome cause of mind—illness.

270. *Upon my knees.*—In the cold, dank morning under the grey dawn what a sight is here! And the appeal by 'the once-commended beauty' has a sad world of meaning.

275. *What men.*—She has been wakeful the night through, and has seen all.

277. *Six or seven.*—Their very number noted. There were six of them.

278. *Even from darkness.*—Notice the descriptive power of this.

279. Still using his own words as weapons against him.

283. *In sort.*—After a fashion.

284. *To keep.*—To dwell. At Cambridge a man 'keeps' on such and such a staircase.

285. *Suburbs.*—On the outskirts, not in your heart of hearts. A double meaning connected with the next line but one is involved. The disorderly parts of most towns were in the suburbs.

291. It is difficult to know which is more admirable in this speech, its womanly dignity or its womanly ingenuity.

295. *Cato's daughter.*—See *Dramatis Personæ* notes.

300. *Voluntary wound.*—After the old Roman manner.

302. *O ye gods!*—Brutus was no real believer in the gods of Rome. But in moments of strong emotion old habits come back to men, and here only in the play does he appeal to deity.

308. *Characters.*—Meaning. Polonius uses the word as a verb, and with the same unusual accent, in his advice to Laertes ('Hamlet,' I. iii. 58):

> 'And those few precepts in thy memory
> See thou character.'

309.—*Who's that knocks?*—Note the omission of the relative pronoun.

310. *Sick man.*—Lucius observes.

311. Metellus has obeyed the behest of Brutus. According to Plutarch this interview took place in the sick room of Ligarius. By making the sick man come here, and in the early morn, Shakspere not only surmounts a dramatic difficulty; he makes a good dramatic point; the devotion of Ligarius is more finely shown.

312. *Boy, stand aside.*—Lucius listens. *How?*—His voice is very gentle.

313. *Vouchsafe.*—Accept.

314. *Chose.*—Chosen. *Caius.*—He calls him by his most familiar name.

315. *Kerchief.*—*Couvre-chef* (Old French for head).

Would you were not sick?—For your own sake and Rome's.

316. The voice growing stronger. No more beautiful testimony to the beautiful character can be given than in this love of man to him. Only the rarer natures move those of their own sex to a love that is almost a passion.

321. *I here discard my sickness.*—Casting away the kerchief.

323. *Exorcist. Ex-orior*=I arise out of, and hence the exorcist was the caster-out of spirits. Here the word is used for the raiser of them.

324. *Mortified.*—Dying.

328. Ligarius has more than guessed.

331. The demonstrative has vanished. Compare with line 309. *Set on your foot.*—Casca (I. iii. 119) will set his foot 'as far as who goes farthest.'

333. The personal influence of Brutus and men's trust in his honour come out once again.

NOTES ON SCENE II.

1. *Have.*—For 'has.'

3. He is alone, and the influence even upon his strong nature of the superstitions of centuries is real. The acute judgment of Cassius (II. i. 199) is verified.

5. Compare with line 200 of the preceding scene.

8. This scene with Calpurnia should be studied with Mr. Poynter's remarkable picture in this year's Academy in sight or in memory. The painting is one of the very few that are unmixed joys to the student of Shakspere.

10. *Cæsar shall forth.*—His name is even to himself a source of strength. See I. ii. 212. Observe the omission of the verb of motion. Three other cases occur in the first scene of the third act. *Find them.*

13. *Stood on ceremonies.*—Relied on signs.

16. Recounts to the ears of Calpurnia's women, their mistress also listening! Omission of the relative again. *Watch.*—Rome is Londonised again. The imperial city had no watch until the time of Augustus.

17. *Lioness.*—The men in Act I., scene iii. 20 and 75, talk of the lion: this woman of the lioness.

18. This idea is, perhaps, borrowed from the Bible, Matthew xxvii. 52, 53. In 'Hamlet,' a play written at most two years after 'Julius Cæsar,' reference is made to this fancy (I. i. 113).

21. *Drizzled.*—Frequentative form of dreasan=to fall.

22. *Hurtled.*—Frequentative of 'hurt' in the sense of 'dash.'

In lines 21-24 is a use of mimetic writing, cruelly called onomatopœia by the learned, where the sound of the words employed suits the sense.

25. *All use.*—That which is wont.

26, 27. A touch of fatalism. Not so fine as Hamlet's 'If it be now, it is not to come; if it be not to come, it will be now; if it be not now, yet it will come; the readiness is all' (V. ii. 228).

30. This is the exact line taken as text by Mr. Poynter.

31. *Blaze.*—From blæsan, to proclaim as with a trumpet. Here it has both its primary and its secondary meaning. The ghost in Hamlet uses the noun, 'But this eternal blazon must not be' (I. v. 21), in the primary sense alone.

32, 33. Compare these two epigrams in metre with the phrase on which they are founded, in Plutarch, 'It was better to die once than always to be afraid of death.'

37. This is more after the Hamlet expression. In both characters the noble thoughts on death come when they are within its shadow. *Augurers.*—See II. i. 200. The question comes swiftly from him on the moment of the servant's entry.

38. A redundant 'to.'

42. An ingenious example of the opposite interpretations placeable on omens. Portents are like statistics: they can be made to prove anything. Nevertheless, four times in twice as many lines he uses that name which is even to him a tower of strength.

46. A daring and powerful passage, fitly placed in the mouth of Cæsar.

49. *Consumed.*—Devoured, and therefore lost.

50, 51. A woman's ingenuity is never keener than when it is exercised in finding excuses for the man she loves.

54. *Upon my knee.*—Compare this pose, and indeed the whole scene between this husband and this wife, with the kneeling of Portia to her lord, and with the duologue between her and Brutus in the first scene. Observe the dramatic skill with which the same position of man and woman is led up to by wholly different means, as it is to be followed by wholly different results.

55. And this after all the 'Cæsar' speeches a moment ago! Yet the decision is both natural and dramatic. Natural—for methinks the Emperor did 'protest too much' above; dramatic—as the scene with Decius that follows gains so much more force in consequence.

56. *For thy humour.*—Man-like, he throws the responsibility, or thinks he throws it, on the woman. Since Adam's 'The woman tempted me, and I did eat,' man has always been trying to do this, with conspicuous ill-success.

63, 64. This is better and braver.

65. The feminine device of a lie—feminine, because man has forced woman, unhappily for both, towards subterfuge. His stern question-answer to her silences her. She speaks no more to the end of the scene. But what a part for silent acting Calpurnia has during the speeches that follow!

69. Decius has a difficult task. His attack upon Cæsar's resolution is conducted with the ability of a lesser Iago. His first weapon is the fear of ridicule: 'Lest I (and you) be laughed at.'

72. The decisive, arbitrary man! Yet in the next lines he tells Decius the reasons, knowing well that through him they will filter privately, if not publicly, to the senators.

74. *Because I love you.*—Decius Brutus was the Brutus dearest to Cæsar actually.

76. *Statue.*—Statua: a trisyllable however spelt.

80. An Alexandrine.

83. His second weapon is an ingenious retranslation of the dream. See note on line 42. Decius knows his man far too well to make the blunder into which a less acute man would fall. The other Brutus would have made the mistake of scorning the superstition of Cæsar. This one makes use of it.

89. *Tinctures.*—Things stained with his blood. See III. ii. 131. At the execution of Strafford, and of many another, the people were wont to dip their handkerchiefs in the blood. Teintures = colours. In heraldry the word means not only colours but metals and furs. *Cognizance.*—Badge.

91. As we praise a book when it says what we would have it say.

93. The third weapon is an appeal to his ambition.

96. And by a dexterous turn at ending he reverts to his first mode of attack—the fear of ridicule. *Mock.*—Taunt. Most of these verbs of jeering have, or had, a corresponding noun. Jeer, gibe, flout, are instances. Bacon in one of his essays, has the phrase, 'Was there never a flout or a dry blow given?'

97. *Apt to be rendered.*—Likely to be used.

101. Finally the hint at cowardice.

103. *To your proceeding.*—With regard to your conduct: qualifying 'tell you this.'

104. My reason is subservient to my love. This sways me to speak strongly.

109. The general entrance of the conspirators is a striking close to this notable scene. Cassius is not with them. The sick Ligarius is next to Brutus.

114. *Struck'n.*—An instance of a verb forming its participle in twofold way. It has the vowel change of the strong verbs and the addition of a syllable of the weak verbs. *Find other instances of this. Eight.*—II. i. 213.

115. His gentlest words are to Brutus.

116. *Revels long o' nights.*—A good line when we consider how all here have spent this last night.

120. Now he has spoken to every one of them by name.

121. *Hour's.*—A dissyllable.

125. *Further.*—Farther. The word 'forth,' and its true comparative 'further,' should only be used with the sense of movement, as 'to go further.' 'Farther' is the comparative of 'far,' the 'th' having crept in by analogy to 'further,' and should be used in such passages as this to denote position.

128. *That every like.*—The seeming friends are really foes. Likeness is not identity.

129. *Yearns.*—Shudders: yrman = to grieve, or shudder. This man alone of them all has a sadness at heart, not less than that of silent Calpurnia.

SCENE III.

1-4. He names every one of the conspirators. The use of alliteration in half of the cases makes the letter rather artificial. The beginning with Brutus and Cassius is good.

6. *Security.*—Carelessness. *Sine* = without; *cura* = care.

7. *Gives way.*—Offers a path.

10. *Suitor.*—One who presents a suit. Had he kept to this idea instead of playing the false move of III. i. 6, 7, the end might have been different.

12. *Emulation.*—Rivalry. *Emulus* = a rival.

14. *The Fates.*—The three Fates were Clotho, Lachesis, Atropos. The ancients, following their usual plan of attempting to propitiate the supernatural powers by giving them conciliatory names, called these the Parcæ, from *parco* = I spare.

SCENE IV.

Perhaps the most dramatic scene in the play. Boy Lucius is here once again playing on the verge of conspiracies. Here he is in contrast with the agitation that is an agony of Portia, as before, we saw him side by side with his tempest-tost master.

1 and 2. There is a pause between these lines and at the end of the second.

5. *Ere.*—Before. The same root is in this as in 'early' and 'erst.'

6. *Constancy.*—'I have made strong proof of my constancy.' II. i. 298.

7. Lest I declare all and with a word bring death to him.

9. A hit at the woman nature, placed in a woman's mouth.

10. *What should I do?*—With eyebrows raised, and wide eyes full of wonder.

13. A pause after 'boy;' she nearly betrays herself.

15. In this line she does completely, were any but a careless boy her auditor.

16. Her distraught fancy is at work.

17. *I hear none, madam.*—Nor do I go running on a fool's errand to the Capitol, unless I am ordered to again.

18. *Fray.*—Short form for 'affray,' of which one old meaning was 'terror.'

Enter a soothsayer.—This part might perhaps be conjoined advantageously with that of Artemidorus and, I doubt not, that in representation it would be. Yet there is a dramatic gain in the introduction of a second who knows of ill threatening. It brings out the fact that plots are in the air.

23. *Ninth hour.*—An hour since the conspirators entered the room of Cæsar.

25. The end is not yet, but draws very nigh.

27. This question is the foreshadowing of the more direct one that her fears prompt a moment later.

30. Note the two verbs with the intensive 'be.'

35. *Prætors.*—The Prætor was a kind of third consul. Sometimes he commanded the army: sometimes, if consuls were away, he exercised their functions in Rome.

37. *Void.*—Empty.

39. No actress could want a speech with more opportunities than this. She almost faints with the stress and strain of it all. At the name of her lord she revives and prays for his success. Then comes the sudden fear that Lucius has overheard, the louder explanation belied by every look and gesture, the faintness again, the dismissal of the boy with the meaningless message that yet may end in news to her, and the staggering homewards as best she may.

(To be continued.)

BY-AND-BY.

T. CRAMPTON.

1st TREBLE.
2nd TREBLE.
BASS.
mf
1. There's a mis-chief-mak-ing fel-low, Who is ev-er com-ing nigh, Threat-'ning
2. Those who heed his treach'rous woo-ing Will his wo-ful guid-ance rue— What we
KEY E. mf
ev-'ry un-der-tak-ing, And his name is By-and-by! "What we ought to do this
al-ways put off do-ing, Clear-ly we shall nev-er do! We may reach what we en-
B. t.
f. E.
min-ute Will be bet-ter done," he'll cry, "If to-mor-row we be-gin it— Put it
-deavour, If on NOW we more re-ly; For un-to the realms of NEV-ER Leads the
p
off!" says By-and-by, "Put it off!" says By-and-by, "Put it off!" says By-and-
pi-lot, By-and-by! Leads the pi-lot, By-and-by! Leads the pi-lot, By-and-
f
by, "Put it off!" says By-and-by.
by, Leads the pi-lot, By-and-by!
Symph. p
Symph.

Notes of Lessons on the Seasons.

No. I.—LENGTHS OF DAY AND NIGHT.

BY JOSEPH H. COWHAM, F.G.S.,
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INFORMATION.

A. Observed differences in the lengths of day and night.

(1) During December and the months near the days are short and the nights long. In June the days are long and the nights short.

(2) In March and September the days and nights are nearly of equal length.

B. Why are days and nights of different lengths at different parts of the year?

(1) Supposed cases which would not explain the above phenomena, but which by contrast serve to make the real cause more apparent.

(*a*) Earth rotating round an axis upright, *i.e.*, perpendicular to the plane of the earth's orbit. In this case the days and nights would be of equal length throughout the globe during the entire year.

(*b*) Earth's axis along the plane of earth's orbit. In this case one-half of the globe would always be in the light and the other half always in the dark.

(2) Inclined position of the earth's axis which explains the difference in the lengths of days and nights in different latitudes at the same time.

(*a*) *Arctic days and nights in December.*—The axis is inclined to the plane of the earth's orbit, so that in December the N. Pole and the district round, as far as the Arctic Circle, rotate entirely beyond the direct sunlight and heat.

(*b*) *Antarctic days and nights in December.*—At the same time the S. Pole and the district round, as far as the Antarctic Circle, are constantly exposed to sunlight and heat.

(*c*) *Days and nights at intermediate latitudes in December.*—Proceed southwards from the Arctic Circle and the December day becomes longer, until at the Equator **the day is as long as the night.** Further south the length of the day continues to increase, until at the Antarctic Circle there is no night.

(3) Reason for the difference in the lengths of day and night in the same latitude at different times.

TEACHING NOTES AND ILLUSTRATIONS.

These facts would be readily given in answer to appeals to knowledge already gained through observation, *e.g.*—

(1) In December it is dark immediately upon leaving school. In June long evenings for outdoor games.

(2) Refer to sun rising at six and setting at six.

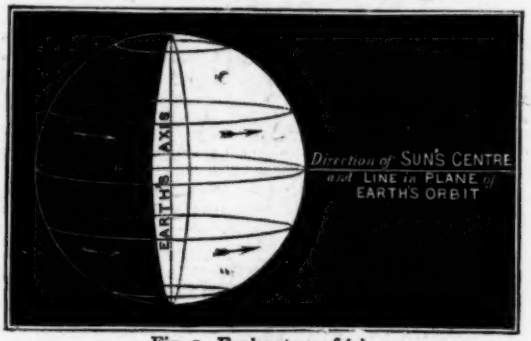


Fig. 1. Explanatory of (*a*).

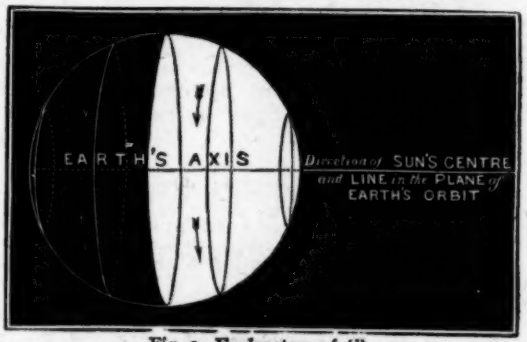


Fig. 2. Explanatory of (*b*).

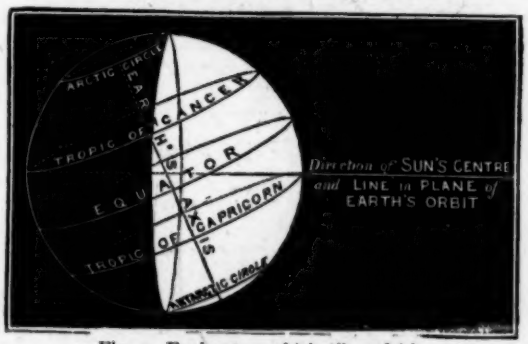


Fig. 3. Explanatory of (*a*), (*b*), and (*c*).

Paragraphs (*a*), (*b*), and (*c*) should be further illustrated by means of a globe and lamp.

Place on the globe a line separating the lighted half from the dark half; then measure parallels of latitude at different distances from the Equator, and show the class by actual measurement that the proportion of lighted parallel increases from Arctic Circle to Equator. Then, again, that this increase continues from Equator to Antarctic Circle.

(*a*) *In six months from December.*—In previous lessons it has been taught that the earth in June is on the opposite side of the sun, as shown in the diagram. Further, if the direction of the axis be maintained, as it is in the diagram, the arctic regions will have constant day, the antarctic regions constant night. At intermediate latitudes, **equal day and night** will again hold at the Equator, whilst northwards from the Equator the days will lengthen, and southwards they will shorten.

(*b*) *In three and nine months from December.*—The days and nights in March and September are about equal in length all over the globe. The CIRCLE OF ILLUMINATION (as the circle separating the lighted from the shaded hemisphere is called) then passes through the Poles.

The conditions necessary for the great change from the short days of December to the long days of June in our latitude are the following:—

(*a*) That the earth's axis be inclined to the plane of its orbit.

(*b*) That the earth take up a position in June on the opposite side of the sun to the position held in December.

(*c*) That the earth's axis be directed in both positions to the same point in the heavens.

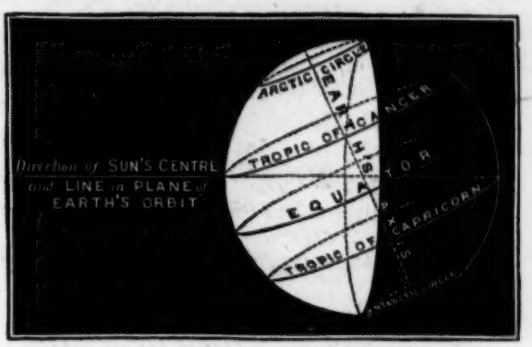


Fig. 4. Explanatory of (*a*).

(*b*) Illustrated by Fig. 1. The earth's axis must be inclined towards or away from the observer.

(*a*), (*b*), (*c*) should be given by the class in answer to questions upon the previous teaching, and form at once a revision and a test.

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Music.

Sight Test—Div. IV. d' d m s fe s f m s l t d' s f m s d' ta l s l t d'.

Div. II. and III. tested from modulator. These intervals were most puzzling: d' m; s, m.

Arithmetic.

STANDARD I.

740	905
82	378
694	527
17	
861	
2394	

Six Times Table.

STANDARD II.

74,305	87,906
28,639	78
45,666	6,856,668

8)59,713

7,464,—1

STANDARD III. (TWO SETS).

A. (1) 700,794,725 ÷ 879. Ans. 797,263,—548.

(2)

£	s.	d.
9030	11	1½
874	13	7¾
8155	17	5¼. Ans.

(3) In a missionary-box there was found 5 h.-crs., 2 five-pd. notes, 8 h.-sovs., 38s., and 11 pence. How much more would be required to make £20?

Ans. £3 8s. 7d.

B. (1) 930,760 ÷ 98. Ans. 9497 + 54.

(2)

£	s.	d.
35,006	18	7¼
1794	18	6¾
33,212	0	0½. Ans.

(3) A man received a legacy of £1504, and he bought 2 cottages value £270 each, and land valued £964. How much money had he left?

Ans. *Nothing left.*

STANDARD IV. (TWO SETS).

A. (1) £8 16s. 9¾d. × 670. Ans. £5923 4s. 4½d.

(2) £30,406 0s. 9d. ÷ 89.

Ans. £341 12s. 9¾d. + 21.

(3) 47 mths. 3 wks. to mins.

Ans. 1,925,280 mins.

(4) £5132 divided among A, B, C, D. A has ¼; B twice as much; C £590; and D the remainder. What does each get?

Ans. A, £1283; B, £2566; C, £590; D, £693.

B. (1) From London to Dover is 75 miles. The fare is 2½d. per ml. What would be the fare for 57 persons? Ans. £40 1s. 6¾d.

(2) Reduce 120,640 sq. ft. to acres.
Ans. 2 ac. 3 rd. 3 per. 3¼ yd. 4 ft.;
or, 2 ac. 3 rd. 3 per. 3 yd. 6¼ ft.;
or, 2 ac. 3724 yds. 4 ft.

(3) £860 0s. 3d. ÷ 97.
Ans. £8 17s. 3¾d. – 45.

(4) £27 13s. 9¾d. × 905.
Ans. £25,060 0s. 3¾d.

STANDARD V. (TWO SETS).

A. (1) 8267 at £6 17s. 10½d.
Ans. £56,990 12s. 7½d.

(2) *Bill*:—28½ lbs. butter at 1s. 6d.
43 „ beef at 9d.
10½ „ mutton at 10d.
6 doz. eggs at 2 for 1½d.
Ans. £4 8s. 3d.

(3) $\frac{3}{4}+\frac{3}{8}+\frac{9}{10}+\frac{9}{10}$. Ans. $2\frac{11}{20}$.

(4) The price of a horse equals 9 cows. If one horse cost £68 10s., how many cows for £4315 10s.?
Ans. 567 cows.

B. (1) 976 at £12 17s. 8½d. Ans. £12,575 3s.

(2) *Bill*:— 8 at 8s. 9d.
11 „ 7s. 6d.
36 „ 3d.
3 „ 1s. 4½d. Ans. £8 5s. 7½d.

(3) Subtract $\frac{1}{8}+\frac{1}{8}+\frac{1}{10}$ from $\frac{9}{10}$. Ans. $\frac{17}{80}$.

(4) If I sell 147 pigs for £1 5s. 3d. each, and with the proceeds I buy 258 turkeys at 16s. 7d. each, what shall I gain or lose? Ans. Gain £28 6s. 9d.

N.B.—The word 'at' is supposed to mean *worth*, otherwise an impossibility is performed. A question so presented is a gross injustice, especially to a *young* examinee.

STANDARD VI. (TWO SETS).

A. (1) If 20 reapers cut 21 acres in 6 days, how many acres would 16 reapers cut in 14 days? Ans. 39½ acres.

(2) A man dies and leaves £3,000. His wife is to receive ·25 of it, and his son ·5 of it, and the remainder goes to his daughter. What did his daughter's share amount to?
Ans. £750.

(3) Int. on £1260 for 8½ yrs. at 6 per cent.
£642 12s.

(4) What is the difference between $\frac{3}{5}$ of $\frac{4}{7}$ of £1, and $\frac{5}{7}$ of a shilling? Ans. 6s. 9½d.

B. (1) If 1⅔ yds. cost 2s. 6d., what will 24½ yds. cost?
Ans. £1 16s. 9d.

(2) Simplify $\frac{(\frac{3}{10}\times\frac{7}{8})+\frac{1}{4}-(\frac{1}{8}\times\frac{3}{4})+7\frac{1}{2}}{1\frac{1}{4}-1\frac{3}{10}}$
Ans. 125½.

(3) Simple int. on £275 10s. for 3¼ yrs. at 2½ per cent. Ans. £22 7s. 8¼d.

(4) Substract $\frac{3}{7}$ from 1·1, and divide the remainder by 0·1. Ans. 6¼.

Music.

BY RALPH DUNSTAN, MUS. BAC., CANTAB.;
L. MUS., T.C.L.;
Member of the Council of the Tonic Sol-fa College, etc.

(Continued from page 358.)

QUADRUPLE TIME, or four-pulse measure.—Each bar or measure contains *four* accents—STRONG, *weak*, medium, *weak*:—

The student will notice that the sign ¢ is used for *Duple* Time, and also for *Quadruple* Time: it always indicates that a *Minim is a beat or pulse*, and a glance at the music will show whether Duple or Quadruple time is intended. The sign C indicates $\frac{4}{4}$ time, the *Crotchet* being a beat. Both C and ¢ are often said to signify '*Common Time*,' of which there are, therefore, at least *three* varieties:—

COMMON TIME—

The term 'Common' as applied to Time is, to a certain extent, misleading; it would be better, therefore to use the terms *Duple* and *Quadruple*, with the signatures $\frac{2}{2}$, $\frac{4}{2}$ and $\frac{4}{4}$, instead of ¢ and C.

THE MAJOR SCALES.—The 'Common' Scale of C or DOH has been already investigated. As we have seen, it consists of intervals called *tones* and *semitones* arranged in a certain invariable order, viz.:—

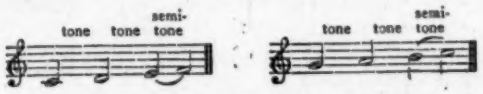
This is called a 'major' scale, because the interval from the *first* (Tonic, or key-note) to the *third*, i.e. C to E, or d to m, is a *major* third. Reckoning the intervals from the Tonic, you will see that *all* are either *major* or *perfect*:—

C to D (d to r) Major second
C „ E (d „ m) Major third
C „ F (d „ f) Perfect fourth
C „ G (d „ s) Perfect fifth
C „ A (d „ l) Major sixth
C „ B (d „ t) Major seventh
C „ C (d „ d¹) Perfect octave

The *semitones* in a Major Scale occur between the *third* and *fourth*, and between the *seventh* and *eighth*.

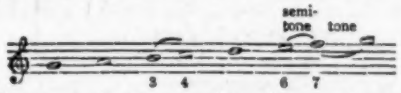
SCALE OF G MAJOR.—In practical music it is impossible to remain always in the key or scale of C. Even in an ordinary hymn-tune, we generally employ *two* different keys; some portions of the tune being in one key, and some in the other. Thus, in a tune beginning in key C, the second or third line would most likely be in key G; and the last line would be in key C as at first.

The two *tetrachords* of the scale, C to F, and G to C[1] have the tones and the semitones in the same order:



If, therefore, we select G as the Tonic, instead of C, a very slight change will suffice to make *a scale starting from G, exactly like the scale of C*, or, in other words, a scale of G major.

On writing the natural notes from G to G, we observe that the semitone falls between the *sixth* and *seventh*, instead of between the *seventh* and *eighth*.



If, however, the F natural be sharpened or raised a semi-tone to F sharp, we shall have the requisite intervals of a *tone* from E to F sharp, and a *semitone* from F sharp to G.

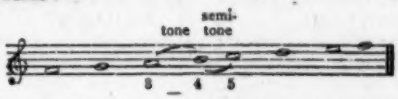
The scale of G requires, then, one sharpened note, or, as we usually say, *one sharp*, viz., F sharp. Now G is a *perfect fifth* higher than C, and if we raise our key-note by another perfect fifth, viz., from G to D, it will be necessary to sharpen *another* note, viz., C:—

Proceeding in this way, we produce in order the following scales:—

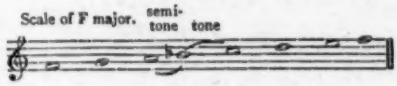
This process might be extended indefinitely, but it is not necessary to carry it further than above.

All these keys requiring *sharps* are often called *sharp keys*, and are produced by *raising* the tonic one or more *perfect fifths*.

If, on the other hand, we start from the scale of C and *lower* our tonic a *perfect fifth* to F, we shall require a different kind of change to complete our major scale:—



Here the interval between third and fourth is a *tone* instead of a semitone, and that between fourth and fifth a *semitone* instead of a tone. All the other intervals are correct. To make the scale of F perfect we must lower or *flatten* the B, making it B *flat*:—

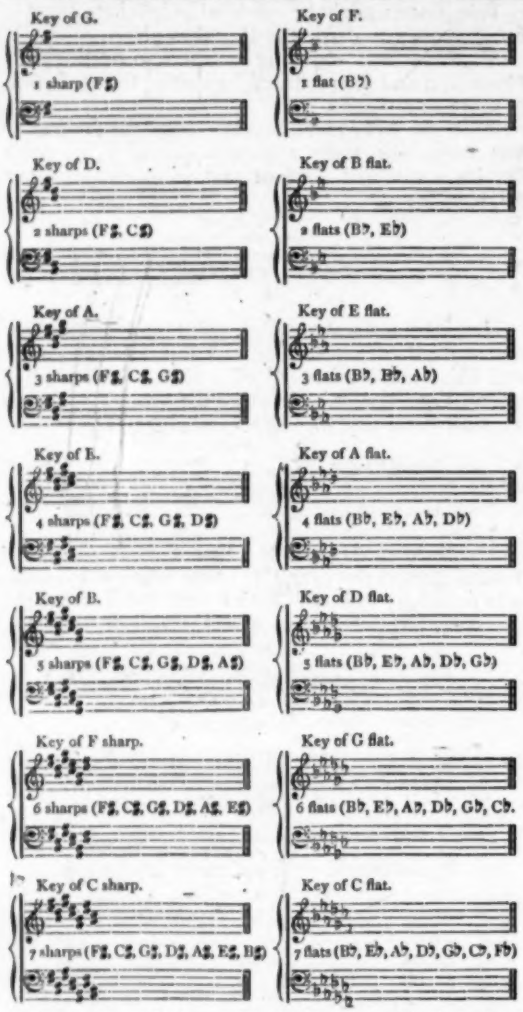


The note a *perfect fifth* below F is B *flat* (*not* B natural; notice this carefully); proceeding in the same way as before, with each *tonic* a perfect fifth *below* the the preceding, we have of *Flat Keys*:—

This process of producing flat keys might also be extended at pleasure.

Key Signatures.—Instead of writing the flat or sharp before each note requiring one, it is much more convenient to indicate *at the beginning* the notes which require to be flattened or sharpened *throughout the piece;* sharps or flats placed at the beginning in this way are called KEY SIGNATURES, and are shown as below:—

Table of Key-Signatures for the Major Scales—


Key of G.
1 sharp (F♯)
Key of F.
1 flat (B♭)
Key of D.
2 sharps (F♯, C♯)
Key of B flat.
2 flats (B♭, E♭)
Key of A.
3 sharps (F♯, C♯, G♯)
Key of E flat.
3 flats (B♭, E♭, A♭)
Key of E.
4 sharps (F♯, C♯, G♯, D♯)
Key of A flat.
4 flats (B♭, E♭, A♭, D♭)
Key of B.
5 sharps (F♯, C♯, G♯, D♯, A♯)
Key of D flat.
5 flats (B♭, E♭, A♭, D♭, G♭)
Key of F sharp.
6 sharps (F♯, C♯, G♯, D♯, A♯, E♯)
Key of G flat.
6 flats (B♭, E♭, A♭, D♭, G♭, C♭)
Key of C sharp.
7 sharps (F♯, C♯, G♯, D♯, A♯, E♯, B♯)
Key of C flat.
7 flats (B♭, E♭, A♭, D♭, G♭, C♭, F♭)

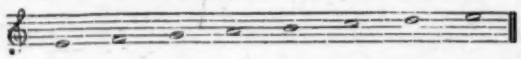
The order of sharps F, C, G, D, A, E, B, and of flats (which is the reverse of this) B, E, A, D, G, C, F, should be carefully remembered, and the student should repeat the following table till it is thoroughly known :—

Key G,	one	sharp,	F.
„ D,	two	sharps,	F, C.
„ A,	three	„	F, C, G.
„ E,	four	„	F, C, G, D.
„ B,	five	„	F, C, G, D, A.
„ F sharp,	six	„	F, C, G, D, A, E.
„ C „	seven	„	F, C, G, D, A, E, B.
„ F,	one	flat,	B.
„ B flat,	two	flats,	B, E.
„ E „	three	„	B, E, A.
„ A „	four	„	B, E, A, D.
„ D „	five	„	B, E, A, D, G.
„ G „	six	„	B, E, A, D, G, C.
„ C „	seven	„	B, E, A, D, G, C, F.

To find the key-note of a piece of music from the signature, observe that in *Sharp* Keys (or keys with sharps) the tonic or key-note is *a semitone above the last sharp* written in the signature, and in *Flat* Keys the tonic or key-note is the *last flat but one* written in the signature.

(The more advanced student may notice that *on the Pianoforte* the key of C sharp is identical with that of D flat, and the key of F sharp with that of G flat. Advantage is sometimes taken of this, and the signature is changed without actually altering the key, either for the convenience of 'playing' or 'writing' the music. Such changes are called *Enharmonic*, and often lead to unexpected and beautiful results.)

EXERCISES.—Add the necessary sharps or flats to make the following a scale of E major :—



and the necessary flats to make the following a scale of E flat major :—

Write out the major *scales* (ascending and descending) of F, G, A flat, B, F sharp, A, D flat, and B flat placing a sharp or flat before each note requiring one.

Write in the following the key-signatures of the notes respectively given as *Tonics* :—

(*To be continued.*)

ANSWERS TO
Pupil Teachers' Examination Papers.
AUGUST 25.
FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Of what sum is $\frac{3}{7}$ of 5s. 4½d. the $\frac{4}{11}$?

Sum required = $\frac{3}{7}$ of 5s. 4½d. $\div \frac{4}{11}$

$$= \frac{5\text{s. } 4\tfrac{1}{2}\text{d.} \times 2 \times 28}{7 \times 3}$$

$$= \frac{5\text{s. } 4\tfrac{1}{2}\text{d.} \times 8}{3} = \frac{43\text{s.}}{3} = 14\text{s. } 4\text{d. Ans.}$$

2. Express ·049$\dot{5}$, ·009$\dot{7}\dot{2}$, ·54$\dot{5}\dot{4}$, and 3·41$\dot{6}$ in vulgar fractions, or mixed numbers, in their lowest terms.

·049$\dot{5}$ = $\frac{49}{990}$ = $\frac{11}{220}$ Ans.

·009$\dot{7}\dot{2}$ = $\frac{972-97}{90000}$ = $\frac{875}{89991}$ = $\frac{7}{719}$ Ans.

·54$\dot{5}\dot{4}$ = $\frac{54}{99}$ = $\frac{6}{11}$ Ans.

3·41$\dot{6}$ = $3\frac{416-41}{900}$ = $3\frac{375}{900}$ = $3\frac{3}{8}$ Ans.

3. Express in decimals the value of $\frac{3{\cdot}75\times{\cdot}966-{\cdot}625\div2{\cdot}5}{{\cdot}05-{\cdot}04375}$

$\{(3{\cdot}75\times{\cdot}966)-({\cdot}625\div2{\cdot}5)\}\div({\cdot}05-{\cdot}04375)=$

$(3{\cdot}6225-{\cdot}25)\div{\cdot}00625=$

$3{\cdot}3725\div{\cdot}00625=\underline{539{\cdot}6}$. Ans.

4. Find the value in money of 2·375 gns. + ·109375 of £5 − 14·625s.

	s.
2·375 gns.	= 49·875
·109375 of £5	= 10·9375
their sum	= 60·8125
deducting	14·625
difference	= 46·1875s. = £2 6s. 2½d. Ans.

5. Find a man's gross rental if, after paying an income-tax of 6d. in the pound on the whole, and 3s. 6d. in the pound on ⅞ of his rental, his net income is £2700.

3s. 6d. in the £ on ⅞ of rental = 2s. 7½d. on the whole; ∴ he pays 2s. 7½d. + 6d., or 3s. 1½d. in the pound over all; hence out of every pound there remains 16s. 10½d. of clear income.

∴ 16s. 10½d. : £2700 :: £1 : net income.

12 | 20

202 | 54000

2 | 12

405 | 648000

2

405) 1296000 (£3200. Ans.

1215

810

810

FEMALES.

1. Reduce $\frac{11}{17}\frac{17}{19}\frac{19}{23}$ to its lowest terms, and find the L. C. M. of 2,304 and 1,728.

(*a*) The terms of $\frac{11}{17}\frac{17}{19}\frac{19}{23}$ divided by 2,751, their G. C. M. = $\frac{4}{23}$. Ans.

(*b*) The G. C. M. of 2,304 and 1,728 is 576; ∴ their L. C. M. is

$\frac{2{,}304\times1{,}728}{576}=2{,}304\times3=\underline{6{,}912}$. Ans.

2. Find by Practice the cost of 1,734 articles at £11 19s. 10½d. each.

		£	s.	d.
Cost of 1,734 at £1 each	=	1734	0	0
				11
" " £11 "	=	19074	0	0
" " 10s. "	= ½ cost at £1 =	867	0	0
" " 5s. "	= ½ " " 10s. =	433	10	0
" " 4s. "	= ⅕ " " £1 =	346	16	0
" " 8d. "	= ⅙ " " 4s. =	57	16	0
" " 2d. "	= ¼ " " 8d. =	14	9	0
" " ½d. "	= ⅛ " " 2d. =	1	16	1½
		20795	7	1½

3. Make out the following bill: 26¾ lb. of cheese at 9d. per lb.; 14lb. of bacon at 88s. 8d. per cwt.; 17½ lb. of butter at 15d. per lb.; 8 doz. and 8 eggs at 1s. 1½d. per doz.; 25 lb. of lard at 7½d. per lb.; 43 lb. of soap at 4½d. per lb.

			s.	d.			£	s.	d.
26¾	lb.	cheese at	0	9	per lb.	=	1	0	0¾
14	"	bacon "	88	8	" cwt.	=	0	11	1
17½	"	butter "	1	3	" lb.	=	1	1	10½
8⅔	doz.	eggs "	1	1½	" doz.	=	0	9	9
25	lb.	lard "	0	7½	" lb.	=	0	15	1½
43	"	soap "	0	4½	" "	=	0	17	0½
							4	14	10¾ Ans.

4. Add together 1⅛, ⅝, ¼, and $\frac{7}{10}$, and subtract their sum from 3. Say how you determine the right common denominator in this case.

$3-(\frac{1}{8}+\frac{5}{8}+\frac{1}{4}+\frac{7}{10})=3-\frac{72+15+10+7}{40}$

$=3-\frac{104}{40}$

$=3-2\frac{4}{5}=\frac{1}{5}$. Ans.

Since the denominator 40 is a common multiple of 5, 8, and 4, it is the least common denominator of 5, 8, 4, and 40, and therefore the right common denominator to use in this case.

5. What would be the price of one thousand and four tons of copper at £81½ per cwt.?

Price of 1004 tons at £81½ per cwt. $=\frac{£81\frac{1}{2}\times1004\times20}{8}$

$=\frac{£653\times1004\times20}{8}$

$=£653\times2510$

$=\underline{£1{,}639{,}030}$. Ans.

Grammar.

1. 'Slowly and *sadly we laid him down*,
From the field *of his fame* fresh and *gory*;
We carved *not a line* and we raised not a stone,
But we left him *alone* with his glory.'

WOLFE.

(*a*) Parse the words printed in italics.
(*b*) Analyse the whole passage.

PARSING.

sadly—adv. of manner, mod. 'laid.'
we—pers. pron., 1st pers., plur., masc., referring to 'soldiers,' nom., subj. of 'laid.'
laid—irreg. trans. verb, *lay, laid, laid*, indic., past indef., 1st pers., plural, agr. with 'we.'
him—pers. pron., 3rd pers. sing., masc., obj. gov. by 'laid.'
down—adv. place, mod. 'laid.'
of—prep. gov. 'fame,' which it relates to 'field.'
his—pronom. poss. adj. limiting 'fame.'
fame—abstr. noun, neut., sing., obj. gov. by 'of.'
gory—predic. adj. qual. 'fame.'
not—neg. adv. mod. 'a.'
a—num. adj. qual. 'line.'
line—com. noun, sing. obj. gov. by 'carved.'
but—advers. [co-ord. conj. contrasting two principal sents., 'we raised not a stone' with 'we left him alone with his glory.'
alone—predic. adj. qual. 'him.'

ANALYSIS.

Sentence.	Kind.	Subject.	Predicate.	Object.	Extensions.	Connective.
1. Slowly and sadly we laid him down, from the field of his fame fresh and gory.	Principal	we	laid	him from the field of his fame fresh and gory	down (place) slowly and sadly (manner)	
2. We carved not a line	Principal	we	carved not	a line		
3. and we raised not a stone	Principal	we	raised not	a stone		and
4. but we left him alone with his glory.	Principal	we	left	him alone with his glory.		but

2. Say what is the use of the final syllable in each of the following words, and give three other words formed in the same way: duck*ling*, sandy, thought*ful*.

-ling forms nouns from nouns, and is used to give a diminutive idea, as duckling (a *little* duck); gosling (a *little* goose); darling (a *little* dear); sapling (a *young* tree).

-y means 'consisting of' or 'having the qualities of,' and forms adjectives from nouns, as sandy (consisting of sand); woody (consisting of wood); stony (containing or consisting of stones); thorny (full of thorns).

-ful means 'full of,' 'addicted to,' and forms adjectives from nouns, as boastful (addicted to boasting); trustful (inclined to trust); joyful (abounding with joy).

3. In how many ways may the word 'that' be employed? Illustrate your answer by sentences.

(1) That may be a demonstrative adjective, as 'Lift that book.' (2) A demonstrative pronoun, as 'Tell him that.' (3) A relative pronoun, as 'This is the book that I referred to.' (4) A conjunction, 'I knew that Parliament was prorogued.'

Geography.

(*Answer either Question* 2 *or Question* 3, *not both.*)

1. Describe fully the position and character of the Cotswold Hills, and of the rivers which drain the country on each side of them.

Draw a map illustrative of your answer.

The Cotswold Hills, a limestone range running through Gloucestershire (30 miles long and 20 broad), form a range of high tablelands with a very steep escarpment looking out over the Severn valley, and with a gradual slope on their eastern side. They separate the basins of the Thames and Severn. Their soil will grow little but a thin grass, which, however, feeds numerous flocks of highly-prized sheep.

The Thames, the most important river in England, has its springs in the Cotswold range not far from the estuary of the Severn, flows through the low ground between the Edge Hills and Marlborough Downs, and after a time parts by its channel the Ilsley Downs from the Chilterns. It now enters a valley consisting chiefly of a great basin of low clay enclosed between ranges of hills, from which smaller streams are thrown down; to the north lie the Chilterns and the East Anglian Hills, to the south the Hampshire Downs and the Wealden Heights. The scenery of the Thames valley is throughout of a very quiet character. But as it widens to its estuary it becomes the most splendid natural harbour of the British Islands, and has by its form and position become the trading centre of the world.

The Avon, a tributary of the Severn, rises in the Cotswolds, and though its course is short, it has at its opening into the estuary of the Severn the most important harbour of the Bristol Channel, that of Bristol itself.

2. Say what you know about the physical features and mining industries of the Counties of Durham and Lanark.

Durham consists of three parts—a small portion to the west lies in the moorlands of the Pennine chain, and contains lead mines; a broad tract of coal measures stretches from Northumberland across the centre of the shire; and a belt of undulating agricultural land extends along the coast, in the southern parts of which salt-mines are found.

The form of the county is clearly marked by its rivers, which all rise close together in the mountains forming its western point, and all make important harbours at their mouth. The rivers are the *Tyne* and its tributary the *Derwent;* the *Tees;* and the *Wear* (which winds through the centre of the country). Sunderland is one of the most important seaports in England for the shipment of coal. Durham is one of the chief coal and lead-producing counties of England.

Lanarkshire coincides exactly with the basin of the Clyde from its source to nearly the head of its estuary. The county is composed of parts of a very different character; the upper valley of the Clyde (Clydes-dale) is a waste uncultivated tract of country, with smooth rounded hills and wide bleak pasture lands. From this pastoral district the river enters, by a series of falls, on its lower agricultural valley, where, just below the Falls, the town of Lanark lies among cultivated hollows of orchards and cornfields, dotted with thriving villages.

The principal tributaries of the Clyde are the Avon, the Douglas, and the Cart. The highest hill in the county is Tinto. Lanarkshire is divided into the Upper, Middle, and Lower Ward, the latter being the most important. The coal and iron mines round Airdrie are very extensive and valuable.

3. A traveller goes from Adelaide to Port Darwin. Describe his journey, and the nature of the country he has to pass through.

Leaving Adelaide he would proceed at first in a northerly direction through the fertile plain in which the town is situated, and skirting the Gulf of St. Vincent, continue along the margin of Spencer Gulf towards the 'Far North,' as the district above that gulf is called. Leaving this rich mineral region, in which agriculture has scarcely been attempted, he will soon find himself among the shallow salt pools and sand hills on the eastern side of L. Torrens, which is scarcely a lake, but more properly an extensive depression. Continuing north-west, he passes to the left of the inhospitable shore of L. Eyre, and proceeds along the route of the Overland Telegraph, through what is by some supposed to have been at one time a great inland sea, and the large district of lakes to the south seem to bear out this conjecture. Following the 'Line' he traverses the dreary desert of the interior, passes Mount Stuart and reaches the table-land of Arnhem Land, as the great north-central peninsula is called. This is a plateau from 2,000 to 3,000 feet high. He soon afterwards reaches Port Darwin, a station of the Overland Telegraph, having journeyed at least 2,000 miles, and having undoubtedly suffered many privations.

History.

1. Who was Julius Agricola? Why is he remarkable in our history?

Julius Agricola was a Roman commander who invaded Britain (A.D. 78-84), conquered Boadicea, reduced Wales, overcame the army gathered together by Galgacus, and secured all the country south of the Clyde and the Frith of Forth, by a fortified wall, called 'Agricola's Wall.' He was the first Roman who circumnavigated Britain. His son-in-law, Tacitus, wrote his biography.

2. What is the meaning of Heptarchy? When and how did the Heptarchy end?

Heptarchy is the name commonly assigned to the earliest period of Anglo-Saxon government in England, when there were seven different kingdoms, independent of each other except for mutual defence against a foreign enemy. One of the monarchs was usually elected as supreme king, with the title of Bretwalda.

Egbert, of Wessex, is reckoned the eighth Bretwalda, and is considered to have attained the dignity in the year 827. Although he was not, strictly speaking, the first king of all England, he certainly laid the foundation of what afterwards became the English monarchy. The royal house of Wessex never lost the ascendancy which he acquired for it as long as the Anglo-Saxons remained masters of England.

3. Explain Thanes, Franklins, Thralls; and describe the condition of the third class.

Thanes were inferior nobles amongst the Saxons. A thane required to be the possessor of at least 600 acres of land. By the introduction of the feudal system under the Normans these thanes were reduced to the condition of mere petty freeholders, called *franklins.*

Thralls were bondsmen, slaves, or serfs among the Saxons. Most of these were probably captured Britons or their descendants, but freemen were made slaves for crime or debt. The ceremony of slave-making was a sad and humiliating sight. The unfortunate captive was forced to lay down the sword and spear which he had carried as a freeman, and in a kneeling posture he placed his head under his master's hand, and took up the bill and the ox-goad. The buying and selling of slaves was quite common, the usual price being about four times the price of an ox.

Composition.

Write from memory the substance of this passage read to you by the Inspector.

In the desert between Herat and Khiva we were joined, says an English traveller, by a caravan returning to Khiva with slaves. Some of the women were very decently clad, and seemed to have been in good circumstances until seized for this inhuman traffic. One poor woman was mounted astraddle upon a camel behind her master. Her infant child was lodged in a grain-bag hanging from the saddle. The older children, having plenty to eat and nothing to do, probably rather enjoy themselves. But the men are chained together by the neck at night, so that rest is scarcely possible, whilst the contact of the frozen iron with their skin must be a torture. They have to walk the whole way, every step of which renders their captivity more hopeless.

Needlework.

FEMALES.

(*One hour allowed for this Exercise.*)

Music.

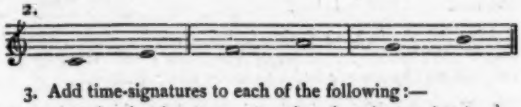
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

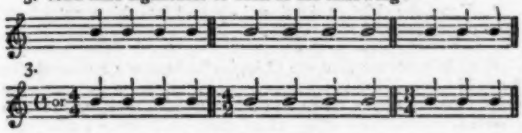
STAFF NOTATION.

1. Write above each of the following notes its value-name (semibreve, &c.); and write below each its pitch-name (C, D, E, &c.):—

2. Write down the major thirds contained between the notes of the scale of C.



3. Add time-signatures to each of the following:—



TONIC SOL-FA NOTATION.

1. Write a four-pulse tone, using two-pulse measure

1. |1 :— |— :— ‖

2. Write down the major thirds contained between the notes of the common scale.

2. *Doh* to *me*; *fah* to *lah*; *soh* to *te*.

3. On what three tones of the scale can major chords be raised?

3. On *doh*, *fah*, and *soh*.

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed for this Paper.

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

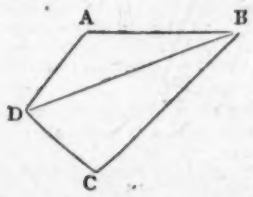
1. If two triangles have two sides of the one equal to two sides of the other, each to each, and have likewise the angles contained by those sides equal to each other, they shall likewise have their bases or third sides equal, and the two triangles shall be equal, and their other angles shall be equal, each to each, viz., those to which the equal sides are opposite.

Prop. 4, Bk. I.

2. To draw a straight line at right angles to a given straight line, from a given point in the same.

Prop. 11, Bk. I.

3. Any three sides of a quadrilateral are greater than the fourth. (Apply I. 20.)



Let ABCD be a quadrilateral; any three of its sides are together greater than the fourth.

Join BD.

Then DB, BC are together greater than the side DC (I. 20). But DA, AB are greater than BD (I. 20); much greater then are DA, AB, BC, than the side DC.

In the same way it may be shown that any other three sides of the figure are greater than the fourth. Q. E. D.

Arithmetic.

FEMALES.

1. Multiply $3\frac{2}{5}$ by $4\frac{3}{7}$, and divide the product by the sum of $3\frac{1}{4}+2\frac{1}{5}+\frac{1}{6}$.

(*a*) $3\frac{2}{5}\times4\frac{3}{7} = \frac{17}{5}\times\frac{31}{7} = \frac{527}{35}$ product.

(*b*) $3\frac{1}{4}+2\frac{1}{5}+\frac{1}{6} = 5\frac{15+12+10}{60} = 5\frac{37}{60} = \frac{337}{60}$

(*c*) $\frac{102}{7}\div\frac{337}{60} = \frac{102\times60}{7\times337} = \frac{6120}{2359} = 2\frac{1402}{2359}$. Ans.

2. What part of 45 guineas is $5\frac{1}{2}$ of $\frac{3}{15}$ of £14?

$$\frac{5\frac{1}{2}\text{ of }\frac{3}{15}\text{ of £14}}{45\text{ gui.}} = \frac{\frac{11}{2}\text{ of }\frac{3}{15}\text{ of £14}}{45\text{ gui.}}$$

$$= \frac{\frac{3}{4}\text{ of }280\text{s.}}{945\text{s.}}$$

$$= \frac{210}{945} = \frac{2}{9}. \quad \text{Ans.}$$

3. Express $\frac{104\frac{1}{2}}{28\frac{3}{4}}$ as a decimal, correct to 5 places, and explain the reason of the rule you employ.

(*a*) $\frac{104\frac{1}{2}}{28\frac{3}{4}} = 1\frac{29}{115}\div1\frac{1}{4} = \frac{209\times4}{2\times115} = \frac{418}{115}$

(*b*) $\frac{418\cdot00000}{115} = 3\cdot63478\ldots\ldots$

To reduce $\frac{418}{115}$ to a decimal form is to find a fraction which shall equal (in this case approximately) $\frac{418}{115}$ and yet shall have 10 or some power of 10 as its denominator. By multiplying the numerator and denominator of the fraction by the same number, 100,000, we do not alter the value of the fraction; then we have $\frac{41800000}{11500000}$. Divide both terms by 115; then $\frac{41800000\div115}{11500000\div115}$ $= \frac{363478\frac{30}{115}}{100000} = 3\cdot63478\ldots$ the decimal equivalent to $\frac{418}{115}$.

4. Reduce $9\frac{9}{16}$ inches to the decimal of a mile, and 3 roods 10 poles to the decimal of $2\frac{1}{4}$ acres.

(*a*)

12	9·9 in.
3	·825 ft.
5·5	·275 yds.
40	·05 po.
8	·00125 fur.
	·00015625 ml. Ans.

(*b*)

40	10 po.
4	3·25 ro.
2·5	·8125 ac.
	·325. Ans.

5. What sum is the same fraction of 5 shillings that 2s. $9\frac{1}{2}$d. is of 21s.?

$$\text{Sum required} = \left(\frac{2\text{s. }9\frac{1}{2}\text{d.}}{21\text{s.}}\right)\text{ of 5s.}$$

$$= \frac{33\frac{1}{2}\text{d.}}{252\text{d.}}\text{ of 5s.}$$

$$= \frac{67}{1260}\text{ of 60d.}$$

$$= \frac{168\times60\text{d.}}{1260} = 8\text{d.} \quad \text{Ans.}$$

Grammar.

1. 'They parted, *ne'er to meet again*,
But never either found another
To free the hollow heart from paining,
They stood aloof, the *scars remaining*,
Like cliffs *which had been rent asunder*,
A dreary sea now flows between;
But neither heat, nor frost, nor thunder
Shall *wholly do away*, I ween
The marks of that which once hath been.'

COLERIDGE.

(*a*) Though these two were once fondly bound together by ties of affection, yet they became estranged, and they separated for ever. Neither of them ever found one who could fill up the painful void in the heart of each, but they lived on, suffering

from the rankling wounds by which their affections had been killed. Like a rock split in two by some convulsion of nature, they seem to be separated by a chasm over which they cannot meet, but live on, scarred and seamed by marks which no earthly change can ever obliterate.

(*b*) PARSING.

Ne'er—neg. adv. of time, mod. 'to meet.'
to meet—irreg. intrans. verb, *meet, met, met*, infin., pres. indef., used absolutely.
again—adv. of time, mod. 'to meet.'
scars—com. noun, neut., plur., nom. absolute.
remaining—reg. intrans. verb, incomplete part. used absolutely with 'scars.'
which—simple rel. pron., referring to 'cliffs,' 3rd pers. plur., neut. nom., subj. of 'had been rent.'
had been rent—irreg. trans. verb, *rend, rent, rent*, pass. voice, indic. past perf., 3rd pers. pl., agr. with 'which.'
asunder—adv. of manner, mod. 'had been rent.'
wholly—adv. of degree, mod. 'shall do.'
do—irreg. trans. verb, *do, did, done*, infin., pres. indef., gov. by 'shall.'
away—adv. of deg., mod. 'shall do' (almost forms part of the verb).

(*c*) ANALYSIS.

Sentence.	Kind.	Subject.	Predicate.	Completion of Predicate.	Extensions.	Connective.
(1) They parted, ne'er to meet again.	Principal	they	parted	to meet again	ne'er	
(2) But never either found another, to free the hollow heart from paining.	Principal	either	found	another (*object*) to free the hollow heart from paining (*complement*)	never	But
(3) They stood aloof (the scars remaining) like cliffs	Principal	they	stood		aloof, the scars remaining (*absolute explanatory phrase*)	
(4) which had been rent asunder.	Subord. adj. to (3)	which	had been rent		asunder	

2. Select from this passage all the infinitives and all the participles.

The infinitives are 'to meet,' 'to free,' 'do.'
The participles are 'remaining,' 'been (2),' 'rent.'

3. Write out six words ending with the syllable *fy*, and six endings in *tion*, and explain the meaning and use of these terminations.

-fy means 'to make,' and is used in forming verbs from the Latin; as, gratify, purify, justify, sanctify, deify.
-tion means 'state' or 'condition,' and is used in the formation of nouns; as, degradation, nomination, gratification, purification, justification, sanctification.

Geography.

(*Answer two questions.*)

1. Explain clearly the effect of difference of longitude on the apparent time at different places. Illustrate your answer by referring to the time at St. Petersburg, Calcutta, and Melbourne, when it is noon at Greenwich.

As the earth goes round on its axis once in every 24 hours, and since the circumference of the earth is divided into 360 degrees, the surface of the earth must move at the rate of 15 degrees an hour, for $15 \times 24 = 360$. We must therefore reckon 1 hour for every 15 degrees, or 4 minutes for every degree, of longitude. If a place is east of Greenwich the people will have the sun earlier, seeing that the earth revolves from west to east. If the place is west of Greenwich then the people at Greenwich will have the sun before the people of that place for the same reason.

The longitude of St. Petersburg being about 30° east, the sun will be overhead there $\frac{30}{15}°$ or 2 hours before it is overhead at Greenwich—that is, it will be about 2 p.m. when it is noon at Greenwich. At Calcutta in 90° east longitude it will be $\frac{90}{15}° = 6$ hours of difference—that is, 6 p.m. At Melbourne nearly 150° E. it is overhead 10 hours earlier—so that the time will be 10 p.m. when it is noon at Greenwich.

2. Draw a full map of Turkey in Europe and Greece; and say what you know about the territories cut off from Turkey after the last war.

After the war in 1878 Turkey lost Roumania, Servia, Montenegro. While Bulgaria is nearly free, Bosnia and Herzegovina are occupied by Austria and Cyprus by Great Britain.

3. Name the chief productions imported into this country from each of our colonial possessions.

Wool is imported from the Colonies in Australia and from the Cape of Good Hope; *silk* from India; *hides* from India and the Cape; *timber* from Canada and other British provinces in North America; *mahogany* from Honduras; *teak* from India and Western Africa; *tea* from Assam; *coffee* from Ceylon; *rum* from Jamaica; *sugar* from the West Indies; *wine* from the Cape; *palm-oil* from Western Africa; *spices* from Ceylon; *oranges* from Malta; *medicinal herbs* from India; *wheat* from British America; *rice* from India; *cotton* and *jute* from India.

SECOND PAPER.

Needlework.

FEMALES.

(The needlework specimens will be collected by the Inspector at the expiry of one hour after the distribution of the examination paper.)

Arithmetic.

MALES.

Two hours and a half allowed.

1. A man lends £1220 for nine months, and gets £41 3s. 6d. for interest. Find the rate of interest per cent. per annum.

$$\left.\begin{matrix} £1220 : £100 \\ 9 \text{ mos.} : 12 \text{ mos.} \end{matrix}\right\} :: £41\ 3s.\ 6d. : \text{rate.}$$

$$\frac{£41\ 3s.\ 6d. \times 100 \times 12}{1220 \times 9} = \frac{9882d. \times 100 \times 12}{1220 \times 9}$$

$$= \frac{44}{11} = 4\tfrac{4}{11} \text{ p.c.} \quad \text{Ans.}$$

2. A man has £3220 in the 3 per cents., and he sells out at $98\frac{3}{4}$; how much money will he get, the broker's charge being $\frac{1}{4}$ per cent.?

He gets $£98\frac{3}{4}$ for every £100.

$\therefore$ £100 : £3220 :: $£98\frac{3}{4}$: money received

$$£98\tfrac{3}{4} \times \tfrac{3220}{100} = \frac{£395 \times 3220}{4 \times 100}$$

$$= £3156. \quad \text{Ans.}$$

3. In a school eighty scholars were examined, and eight failed in reading, ten in writing, and twelve in arithmetic; find the percentage of passes in each subject, and its average percentage.

(*a*) No. of passes in reading $= (80 - 8) = 72$ $\therefore$
" " writing $= (80 - 10) = 70$
" " arithmetic $= (80 - 12) = 68$

80 : 72 :: 100 : 90 percentage in reading.
80 : 70 :: 100 : $87\frac{1}{2}$ " writing.
80 : 68 :: 100 : 85 " arithmetic.

(*b*) No. of possible passes $= (80 \times 3) = 240$; but actual passes $= (72 + 70 + 68) = 210$.

$\therefore$ 240 : 210 :: 100 : $87\frac{1}{2}$ average percentage of school.

4. A man, a woman, and a boy work for 12 days, and earn £3 5s.; what are the wages of each per day if the man gets half as much again as the woman, and the woman a third as much again as the boy?

(*a*) If a boy gets 3 parts, then a woman gets 4, and a man 6; total parts 13.

(*b*) Amount received each day by boy, woman, and man = £3 5s. ÷ 12 = 5s. 5d.

(*c*) ∴ A boy receives $\frac{3}{13}$ of 5s. 5d. or 1s. 3d. Ans.

woman ,, $\frac{4}{13}$,, or 1s. 8d. Ans.

man ,, $\frac{6}{13}$,, or 2s. 6d. Ans.

5. A man in business loses in his first year 5 per cent. of his capital, but in his second year gains 6 per cent. of what he had at the end of the first year, and his capital is now £14 more than at the first. Find his original capital.

Let £100 represent his capital; then at the end of the first year he has £95 left.

∴ 100 : 106 :: £95 : more or less than supposed capital.

$\frac{£95 \times 106}{100} = £100\frac{7}{10}$; that is a gain of $\frac{7}{10}$ per 100 of capital.

Now if every £100 gains £$\frac{7}{10}$, how much will it take to gain £14?

$\frac{7}{10}$: 14 :: £100 : capital.

$\frac{£100 \times 14}{\frac{7}{10}} = \frac{£14000}{7} = £2000$. Ans.

History.

1. What families occupied the throne between the Norman Conquest and the Union of the Crowns of England and Scotland? Name the first sovereign of each family, with his date.

			A.D.
(1) William I.	of the Norman	Dynasty, began to reign	1066
(2) Henry II.	,, Plantagenet	,, ,, ,,	1154
(3) Henry IV.	,, Lancastrian	,, ,, ,,	1399
(4) Edward IV.	,, York	,, ,, ,,	1461
(5) Henry VII.	,, Tudor	,, ,, ,,	1485

(1) Family of William the Conquerer. (2) Family of Geoffrey Plantagenet. (3) Family of John of Gaunt. (4) Family of Lionel, Duke of Clarence. (5) Family of Owen Tudor.

2. In whose reign were the people first represented in a regular House of Commons? Of what classes did that House consist?

In the year 1265, in the reign of Henry III., when that king was held a prisoner after the battle of Lewes by Simon de Montfort, Earl of Leicester, and brother-in-law of the king, writs were issued by de Montfort directing the sheriffs in the king's name to return two knights for their county and two burgesses for every city and borough contained in it. This is always regarded as the foundation of the House of Commons.

3. For what is Geoffrey Chaucer remarkable? Give a short description of his great work, with dates of his birth and death.

Geoffrey Chaucer is remarkable as being the first great writer of English verse; hence called the 'Father of English Poetry.' His great work is the 'Canterbury Tales,' in which he describes the pilgrimage of some twenty-nine or thirty pilgrims to the shrine of St. Thomas-à-Becket at Canterbury. They collected at the Tabard Inn in Southwark, and this gathering contains specimens of nearly every character then common in the streets and homes of England. In the prologue he describes the company, then follows the knight's tale, then the miller's, and so the weary journey is beguiled by the tales of each pilgrim. As Chaucer sketched the plan in his prologue, each pilgrim ought to tell two stories when going to Canterbury, and two on the homeward road, but the poet lived only to complete twenty-four tales. Nothing could surpass these Tales as a series of pictures of the middle-class English life during the fourteenth century.

Chaucer was born about the year 1328, and died 1400, A.D.

Teaching.

What is the best way of arranging a class of twenty scholars for a reading lesson; and how can you make sure that they are all attentive?

A reading class of twenty scholars is best arranged in a semi-circular fashion, the teacher placing himself at such a point as to easily command the class with one look. The teacher should be able to see the face of every one, and every one should be able to see, on looking up, the face of the teacher. The semi-circular arrangement allows the scholars the best chance of hearing one another.

When the pupils are aware that the teacher's eye is ready to detect the least inattention, there is not much fear of neglect, but to prevent this and keep attention alive, instead of allowing one taking up the sentence when his neighbour has finished, the pupil who is to read, may be called upon by name. This, and single-word, or phrase reading for variety, will generally ensure attention. A question, now and again, on the meaning of what is read; some life in the teacher's style, and loss of place for inattention, should keep the pupils keenly attentive, if the lesson is not too long.

Music.

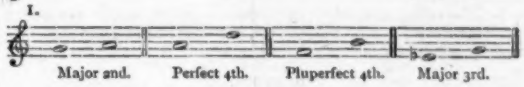
A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

STAFF NOTATION.

1. Write below each of the following intervals its name (minor third, &c.):—

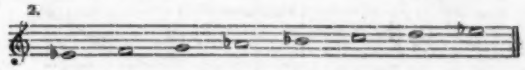
1.



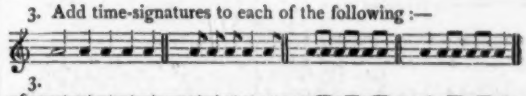
Major 2nd. Perfect 4th. Pluperfect 4th. Major 3rd.

2. Write the scale of E flat, placing the necessary flats before the notes to be flattened.

2.



3. Add time-signatures to each of the following:—



3.

TONIC SOL-FA NOTATION.

1. What is the interval (major third, &c.) (*a*) between *soh* and *lah*; (*b*) between *lah* and *ray*[1]; (*c*) between *fah* and *te*; (*d*) between *doh* and *me*?

1. (*a*) Major second; (*b*) Perfect fourth; (*c*) Pluperfect fourth; (*d*) Major third.

2. What is the mental effect (*a*) of *me*; (*b*) of *lah*?

2. (*a*) Calm and steady; (*b*) Plaintive.

3. Write (*a*) the pulse signs for a four-pulse measure; (*b*) a six-pulse measure.

3. Four pulse (primary form). (*a*) | : | : ‖

Six pulse (primary form). (*b*) | : : | : : ‖

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on or after, 1st May,* 1878; **and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

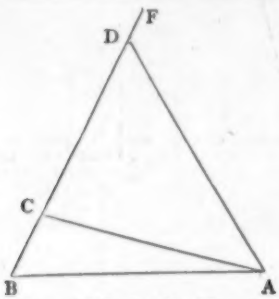
Euclid.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including Question 1, *if you can.*

MALES.

1. Construct a triangle, having given one side, an adjacent angle, and the sum of the other two sides. (Given AB and ∠ABF; in BF take BD = given sum; make ∠DAC = ∠ADC, and prove △ABC is that required.)



Because $\angle DAC = \angle ADC$, the side CD = side CA. (Prop. 6, Bk. I.)

To each of these equals add CB, then DC, CB are together equal to AC, CB. That is, BD = the sum of AC, CB.

But BD is the sum of the two sides of the required triangle.

Therefore the sides BC, CA are together equal to the sum of the two sides.

And the $\angle ABC$ = the given angle, and AB is a given side.

$\therefore$ BCA is the triangle required. Q. E. F.

2. The straight lines which join the extremities of two equal and parallel straight lines towards the same parts, are also themselves equal and parallel.

Prop. 33, Bk. I.

3. The complements of the parallelograms, which are about the diameter of any parallelogram, are equal to one another.

Prop. 43, Bk. I.

Algebra.

Answer two questions.

1. Prove that

$(ax-y)^4-(x-ay)^4=(a^2-1)(x^2-y^2)\{(a^2+1)(x^2+y^2)-4axy\}$

(1) $(ax-y)^4=a^4x^4-4a^3x^3y+6a^2x^2y^2-4axy^3+y^4$

(2) $(x-ay)^4=x^4-4ax^3y+6a^2x^2y^2-4a^3xy^3+a^4y^4$

Subtracting (2) from (1) $a^4x^4-x^4+4a^3x^3y+4ax^3y-4axy^3+4a^3xy^3+y^4-a^4y^4=$ 1st result

(3) $(a^2-1)(x^2-y^2)\{(a^2+1)(x^2+y^2)-4axy\}=$

$(a^2-1)(x^2-y^2)(a^2+1)(x^2+y^2)-4axy(a^2-1)(x^2-y^2)=$

$(a^4-1)(x^4-y^4)-4axy(a^2x^2-a^2y^2-x^2+y^2)=$

$a^4x^4-a^4y^4-x^4+y^4-4a^3x^3y+4a^3xy^3+4ax^3y-4axy^3=$ 1st result.

Q. E. D.

2. Find the G.C.M. of $6x^3-13x^2+8x-3$ and $14x^3-49x^2+84x-63$; also the L.C.M. of x^2-3x+2, x^2-4x+3, x^2-5x+6.

$$
\begin{array}{r|l}
6x^3-13x^2+8x-3 & 14x^3-49x^2+84x-63 \\
\hline
 & 3 \\
\hline
6x^3-13x^2+8x-3 & 42x^3-147x^2+252x-189 \\
 & 42x^3-91x^2+56x-21 \\
\hline
 & -28 \\
\hline
2x-7+6 & -56x+196x-168 \\
\hline
6x^3-13x^2+8x-3 & 6x^3-21x^2+18x \\
\hline
 & 8x^2-10x-3 \\
 & 8x^2-28x+24 \\
\hline
 & 9 \\
\hline
 & 18x-27 \\
\hline
 & 2x-3
\end{array}
$$

$$
\begin{array}{r|l}
2x-3 & 2x^2-7x+6 \\
\hline
2x^2-3x & 2x-3 \\
\hline
 & -4x+6 \\
 & -4x+6 \\
\hline
 & 0
\end{array}
$$

$\therefore 2x-3$ = G.C.M. Ans.

(b) $x^2-3x+2=(x-1)(x-2)$

$x^2-4x+3=(x-1)(x-3)$

$x^2-5x+6=(x-2)(x-3)$

$\therefore$ L.C.M. $=(x-1)(x-2)(x-3)$

3. Solve the equations :—

(1) $\frac{2x+7}{7}-\frac{9x-8}{11}=\frac{x-11}{2}$

(2) $\frac{3x-13}{37}-\frac{7x+25}{38}+\frac{5x+11}{39}=0$

(1) $\frac{2x+7}{7}-\frac{9x-8}{11}=\frac{x-11}{2}$

Clearing of fractions $44x+154-126x+112=77x-847$

$44x-126x-77x=-847-112-154$

$159x=1113$

$x=7$. Ans.

(2) $\frac{3x-13}{37}-\frac{7x+25}{38}+\frac{5x+11}{39}=0$

clearing of fractions

$4446x-19266-10101x-36075+7030x+15466=0$

Collecting and transposing $1375x=39875$

$x=29$. Ans.

Mensuration.

From what proposition in the first book of Euclid is the rule deduced for finding the area of a triangle, whose base and altitude are given?

Find to three decimal places the area of the triangle whose sides are 17, 63, 73.

Prop. 41. If a parallelogram and a triangle be on the same base and between the same parallels the parallelogram shall be double of the triangle.

Half the sum of the sides $=\frac{17+63+73}{2}=76{\cdot}5$

$\therefore$ Area of $\triangle = \sqrt{76{\cdot}5\times(76{\cdot}5-17)\times(76{\cdot}5-63)\times(76{\cdot}5-73)}$

$= \sqrt{76{\cdot}5\times59{\cdot}5\times13{\cdot}5\times3{\cdot}5}$

$= \sqrt{215070{\cdot}1875}$

$=$ 463·756... Ans.

FEMALES.

1. If an ounce of tea cost ·4583 shillings, how much will £30 16s. buy?

·4583s. : £30 16s. :: 1 oz. : ?

12 20

5·5000d. 616s.

12

5·5 | 7392d.

1344 oz. = 84 lbs. Ans.

2. What is the difference between 22·4785 of £1 and 17·2845 of a guinea?

	£	guineas
	22·4785	17·2845
	20	21
	449·5700s.	172845
deduct	362·9745s.	345690
	86·5955s.	362·9745
	12	
	7·1460d.	

$\therefore$ difference is £4 6s. 7·146d. Ans.

3. If I give £1 10s. 11½d. for 4½ yds. of velvet, what quantity could I purchase for £14 1s. 10½d.?

£ s. d. £ s. d.
1 10 11½ : 14 1 10½ :: 4½ yds. : ?
20 20
30s. 281s.
12 12
371d. 3382d.
4 4
1485f. 13530f.
4½
6765
54120
)60885(41 yds Ans.
5940
1485
1485

4. Explain why, when you work a proportion sum, you multiply the second and third terms together and divide by the first.

Whenever four terms are in proportion, the product of the two extreme terms is equal to the product of the two mean terms.

Hence any term of a proportion can be found if the remaining three are known; for example, if the required term be a mean term, find the product of the extremes, and divide by the remaining mean; if the remaining term be an extreme (as in this case) find the product of the mean terms, and divide by the extreme.

5. Three persons purchased a chest of tea containing 95 lb. for £11 1s. 8d. The first contributed £3 10s., the second £4 13s. 6d., and the third the rest. How many lb. should each receive?

	£	s.	d.
1st contributed	3	10	0
2nd ,,	4	13	4
∴ 3rd ,,	2	18	4

Hence $£11\frac{1}{3} : £3\frac{1}{2} :: 95$ lbs. : share of 1st.

$$95 \text{ lb.} \times \frac{3\frac{1}{2}}{11\frac{1}{3}} = \frac{95 \text{ lb.} \times 18}{133}$$

$$= \underline{30 \text{ lb.}} \text{ Ans.}$$

$£11\frac{1}{3} : £4\frac{3}{4} ::$ 95 lb. : share of 2nd.

$$95 \text{ lb.} \times \frac{4\frac{3}{4}}{11\frac{1}{3}} = \frac{95 \text{ lb.} \times 56}{133}$$

$$= \underline{40 \text{ lb.}} \text{ Ans.}$$

Hence the 3rd gets 25. Ans.

Grammar.

1. It was at Rome, on the 15th of October, 1764, as I *sat musing* amidst the ruins of the Capitol, while the barefooted friars *were singing* vespers in the temple of Jupiter, that the idea of writing the decline and fall of the city first started in my mind. But my original plan *was circumscribed* to the decay of the city *rather than of the empire;* and though my reading and reflections began to point towards that subject, some years elapsed and several avocations intervened *before I was* seriously engaged in the execution of that laborious work. GIBBON.

(*a*) Paraphrase this passage. (*b*) Analyse the first sentence. (*c*) Parse the words printed in italics.

(*a*) On the 15th of October, 1864, while thinking of the past in the ruined Capitol of Rome, and listening to the monks singing the evening hymn in an adjoining monastery, my meditations led me on to the notion of writing a history of the decay of the city of Rome. At first I purposed confining my history entirely to the City; and though the whole bent of my studies and researches afterwards gradually led me to entertain the idea of giving the history of the fall of the Empire, yet several years passed before I had leisure to undertake the performance of such a stupendous task.

(*b*)

ANALYSIS.

Sentence.	Kind.		Predicate verb.	Completion of Pred.	Extensions.	Connective.
(1)						
It was at Rome, on the 15th of October, 1764.	Principal	it	was	at Rome *and sent.* (4)	On the 15th of October, 1764 (time).	
(2)						
As I sat musing amidst the ruins of the Capitol.	Subord. adv. to (1).	I	sat	musing	amidst the ruins of the Capitol (place).	as
(3)						
While the barefooted friars were singing vespers in the temple of Jupiter.	Subord. adv. to (2).	the barefooted friars	were singing	vespers (*object*)	in the temple of Jupiter (place).	while
(4)						
That the idea of writing the decline and fall of the City first started in my mind.	Subord. noun to (1)	the idea of writing.. city	started	in my mind	first	that

PARSING.

Sat—irreg. intrans. verb. *sit, sat, sat*, indic., past, indef., 1st pers. sing, agree with 'I.'
musing—reg. intrans. verb, incomplete part., predic. of 'I.'
were singing—irreg. trans. verb, *sing, sang, sung*, indic. past, progressive 3rd pers., plur., agr. with 'friars.'
was circumscribed—reg. trans. verb, passive voice, indic., past indef., 3rd pers., sing., agr. with 'plan.'
rather—adv. manner, mod. 'was circumscribed.'
than—conj. subord. connecting 'of the city' and 'of the empire.'
of—prep, showing the relation bet. 'decay' and 'empire,' gov. obj. case 'empire.'
the—def. art. or dist. adj. limiting 'empire.'
empire—com. noun, neut., sing., obj. gov. by 'of.'
before—subord. temporal conj, connect. 'I was...work' with 'some years elapsed...intervened.'
I—pers. pron. standing for ('the writer') 1st pers. sing., masc., nom., subj. of 'was.'
was—irreg intrans. verb (here auxiliary of voice), *am, was, been*, indic. past indef., 1st pers. sing, agr. with 'I.'

2. In the words *decline, circumscribe, reflection, execution*, and *laborious*; say what is the use of the prefix or affix, and how it modifies the meaning of the rest of the word.

The prefix *de* means 'from,' and modifies the other part so as to mean 'bending from' or 'refusing'

The prefix *circum*, 'round,' modifies the other part of the word so as to mean 'marking a line round,' and thus 'limiting.'

The affix *tion* forms a noun from 'reflect,' and the prefix *re*, meaning 'back,' modifies the root so as to mean 'the act of throwing or bending back.'

The affix *tion* changes the verb 'execute' into the noun 'execution,' which means 'the act of executing.'

The affix *ous* changes 'labour' into an adjective, making 'laborious,' which means 'full of labour.'

Geography.

(*Answer two Questions.*)

1. Give notes of a lesson on 'Land and Sea Breezes, their causes and effects.' Give illustrations from the Coasts of Africa and Asia.

DEFINITION.—Land breeze blows from the land towards the sea. Sea-breeze blows from the sea towards the land.

CAUSE.—If the sun shine on two tracts of surface, the one water and the other solid ground, the latter becomes more rapidly heated than the former, and at the end of the day will be found much warmer than the water. On the other hand, in the absence of the sun, the land cools fastest, and at the end of the night it will be found below the temperature of the adjoining water.

When the land is hottest the air resting upon it will be hotter and lighter than the air over the sea, and the cold air from the sea will rush in upon the hot. Thus during the day there will be a breeze from the sea to the land, and during the night a breeze from the land to the sea. These sea and land-breezes are felt regularly on all sea-coasts when not overborne by other winds.

EFFECT.—On the west coast of Africa (Sierra Leone), where the trade-winds do not blow, the land and sea-breezes are very regular. The sea-breeze sets in about 10 a.m. and is cool and pleasant. The land-breeze begins about 9 at night and is always unhealthy. In South Africa (Cape Colony) no such disease as fever is known. This arises from the fact that this part of the continent is thoroughly exposed to the sea-breeze, which carries off noxious vapours. The heat of India round the coast is modified materially by the local sea-winds which set in after the north-east monsoon ends, and gradually culminate in the south-west monsoon. These monsoons are really land and sea-breezes, the one blowing six months from the sea, and the other six months from the land. The heat of Cyprus and Ceylon is mitigated by the sea-breezes.

2. Draw a full map of Arabia and Palestine.

3. Give a full account of Egypt.

Egypt is a country in the north-east of Africa, forming the chief part of the Egyptian dominions; it is bounded on the north by the Mediterranean; west, by Barca and the Libyan desert; south by Nubia; east, by the Red Sea and the Isthmus of Suez.

This country consists of the valley of the Nile, 500 miles in length and averaging about 10 miles in breadth, bounded on both sides by mountains and barren deserts. The mouths of the Nile give to the lower portion of the valley from their shape the name of Delta, the greatest breadth of which is 150 miles. The geographical divisions of Egypt Proper, are Lower, Middle, and Upper Egypt. The principal towns are Cairo, Alexandria, Rosetta, Tanta, Damietta, Port Said, Ismailia, Suez, Siout, Girgeh, Esneh.

The only river of Egypt is the Nile, whose waters begin to rise at Cairo in June, attain their greatest height in September, and after remaining stationary for a few days begin to subside gradually till the end of November. On the retiring of the waters the ground is covered with a rich layer of mud, which imparts an unparalleled fertility to the soil. Much of the water is retained in canals, which are spread like a net-work over the Delta and the narrow valley above for the purpose of irrigation.

The climate is extremely dry, and this fact mainly accounts for the wonderful state of preservation of the numerous ancient monuments which abound in the Nile valley. During spring the country is visited by a pestilential wind called the Khamsin, and on the subsiding of the Nile by fatal fevers, ophthalmia, and dysentery. The country has been lately visited by a fatal epidemic very similar to Asiatic cholera.

In Egypt agriculture has in all ages been carried to its highest perfection. The principal cultivated plants are cotton, hemp, flax, indigo, sugar, tobacco, and opium; the cereals comprising wheat, millet, maize, rice, and durrah—the last forming with beans the main food of the people. Onions, melons, and cucurabers are also raised.

The principal wild animals are the crocodile, iehneumon, jerboa, and fox.

No account of Egypt would be complete without an account of the railway and canal which have made it once more the highway of commerce between the east and west. The railway from Alexandria to Suez past Cairo has done much to effect this, but much more has been done by the canal connecting the Mediterranean with the Red Sea. Beginning at Port Said it stretches almost directly south by Ismailia to Suez, a distance of 100 miles. In 1875 one half the total number of shares were purchased by our Government. Since the late war in Egypt a project for constructing another canal has been discussed.

SECOND PAPER.

Two hours and a half allowed.

FEMALES.

Needlework.

(The needlework specimens will be collected by the Inspector at the expiration of one hour after the distribution of the examination paper.)

MALES.

Arithmetic.

1. A woman buys mackerel at 6s. 3d. a score; how ought she to sell them per dozen so as to gain 40 per cent. on her outlay?

20 mackerel cost 6s. 3d.
1 ,, ,, $3\frac{1}{4}$d.
∴ 12 ,, ,, 3s. 9d.
Hence 100 : 140 :: 3s. 9d. : selling price.

$$\frac{3s.\ 9d. \times 140}{100} = \frac{3s.\ 9d. \times 7}{5} = \underline{5s.\ 3d.} \quad \text{Ans.}$$

2. A man buys 4 per cent. £100 debentures at a premium of £24 17s. 6d.; what interest will he get for his money, the usual brokerage being charged?

Price of every £100 = £124 17s. 6d. + 2s. 6d.
= £125
∴ 125 : 100 :: £4 : interest required.

$$\frac{£4 \times 100}{125} = \underline{£3\frac{1}{5}\ \text{p.c.}} \quad \text{Ans.}$$

3. A man lends a certain sum of money at $4\frac{1}{2}$ per cent interest, and at the end of 9 months he receives for interest and principal £1860 15s.; what was the principal?

Interest of £100 for 9 mos. at $4\frac{1}{2}$ p.c. = £$4\frac{1}{2} \times \frac{9}{12}$ = $3\frac{3}{8}$
Amount ,, ,, ,, = $103\frac{3}{8}$
∴ $103\frac{3}{8}$: $1860\frac{3}{4}$ :: £100 : principal.

$$\frac{£100 \times 1860\frac{3}{4}}{103\frac{3}{8}} = \frac{£100 \times 14886}{827}$$
$$= \underline{£1800.} \quad \text{Ans.}$$

4. A grocer buys 5 cwt. 3 qrs. of tea for £80 10s., but 23 lb. get spoiled; how ought he to sell the remainder per lb. so as to gain 35 per cent. on his outlay?

(*a*) 5 cwt. 3 qrs. = 644 lbs.
deduct the damaged 23 ,,
rem. to be sold 621 ,,

(*b*) 100 : 135 :: £80 10s. : selling price of 621 lbs.

$$\frac{1610s. \times 135}{100} = 2173s.\ 6d.$$

(*c*) ∴ Selling price required $= \frac{2173s.\ 6d.}{621} = \underline{3s.\ 6d.}$ Ans.

5. If the true discount on a certain sum of money due 12 months hence be £15, interest being at 5 per cent., what would a banker's discount be for the same?

Difference between true and banker's discount equals interest on the true discount for the given time.

Interest on £15 for 1 year at 5 p. c. $= \frac{£15 \times 5}{100}$

,, $= \frac{1500s.}{100} = 15s.$

∴ The banker's discount = £15 15s. Ans.

History.

1. Who was the first king of Great Britain, and why was he so styled?

James VI. of Scotland was the first king of Great Britain, who assumed the sceptre under the title of James I. (1603). At the suggestion of the King, who wished to obliterate all distinctions between England and Scotland, the two countries henceforth received the common designation of *Great Britain*.

2. In a recent meeting of his old schoolfellows, Archbishop Benson spoke of succeeding to the throne of the 'martyred Laud.' Fully explain the allusion.

Archbishop Benson referred to Laud who occupied the archiepiscopal throne of Canterbury in the reign of Charles I. He was a martyr in so far as dying for his adherence to episcopacy is concerned. His severity against the Puritans led to his imprisonment by the Long Parliament. After lying three years in the Tower, he was beheaded 1645. His execution has brought much blame on the Long Parliament, from such as forget that he could not be seen into and judged then, as now; and that the party that destroyed him had suffered every outrage in person and property.

3. What was the war of the Spanish succession? Describe the part taken by England in it.

The last work of William III. of England was a new alliance of England, Holland, and the Emperor against Louis XIV. and his grandson. This Grand Alliance was continued in the reign of Anne, and it was joined by many of the European powers. War with France was declared, 1701, the Allies supporting the claim of the Archduke Charles of Austria to the Spanish Crown. In this war of the Spanish Succession, as it is called, the Duke of Marlborough in command of the English and Dutch forces, entered upon that course of splendid achievements which gained him the high rank which he holds among generals. His chief victories were Blenheim (1704), Ramilies (1706), Oudenarde (1708), and Malplaquet (1709). One of the chief events of this war was the capture of the rock and fortress of Gibraltar (1704), which has ever since remained in possession of Britain. The war was ended by the withdrawal of England from the Grand Alliance; and the Peace of Utrecht was agreed to in 1713.

Teaching.

How would you explain to young beginners the formation and use of a river?

As every one must have seen a river, a brook, or at all events a run of water somewhere, as streams of water are absolutely necessary to make a country habitable, we would suppose them walking up the nearest brook, and taking notice of all the little streams that join it, sometimes on one side and sometimes on the other. The main stream would be gradually getting smaller and smaller, until at last it dwindles down to a tiny rill, which would be seen to issue abruptly from the soil or ooze gradually out of a marshy piece of ground. The next question would be how comes the water to be either in the spring or in the marsh. It does not grow there, so the only answer will be that it must drop from the clouds in the shape of rain. One convincing proof would be the fact that in long-continued dry weather one spring after another ceases to flow, and many a brook becomes a dry channel. Rivers are therefore formed by tributary streams having their sources ultimately in springs, or other reservoirs supplied with water from the clouds.

It will be thus seen that rivers are the drains of a country. The water falls from the sky as rain or snow, and naturally drains off by the lowest levels till it reaches the lowest level of all, the sea. As it goes along one drain joins another, until at last they all get united into one large main drain, and this is called the river.

These drains carry away the superfluous water, and sometimes the filth which should have been buried; they are used for turning millwheels, and driving machinery, for inland navigation, for boating, and other uses. They are constantly carrying soil to lower levels, as the children may have seen by the muddy water during a flood. If a glass was filled with this water, and allowed to stand for a short time the solid matter would be found at the bottom of the vessel. Almost all cities are necessarily situated on rivers—a fact for which the children will now be able to give a reason.

Music.

A quarter of an hour allowed for this paper.

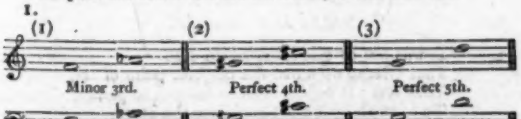
(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

STAFF NOTATION.

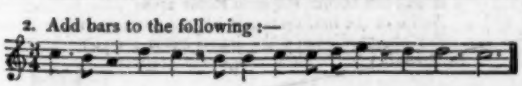
1. Write the names of each of the following intervals :—

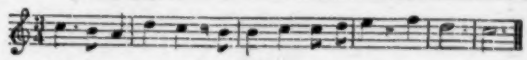
Transpose the above one octave lower, in the bass clef.

1.



2. Add bars to the following :—





3. Explain the following terms :—(1) *Da Capo*; (2) *Dal Segno*; (3) *Staccato*.

3. (1) Play or sing from the beginning again; (2) Return to the mark and play or sing again; (3) Cut off—the notes marked are to be sounded or sung distinct from each other.

TONIC SOL-FA NOTATION.

1. What is the interval (*a*) between *ray* and *fah*; (*b*) between *ray* and *soh*; (*c*) between *me* and *te*? What is the name (*d*) for *doh* sharp; (*e*) for *te* flat.

1. (*a*) Minor third; (*b*) Perfect fourth; (*c*) Perfect fifth; (*d*) *de*; (*e*) *ta*.

2. What are the five kinds of measures commonly used?

2. (1) Two-pulse; (2) three-pulse; (3) four-pulse; (4) six-pulse; and (5) nine-pulse.

3. Explain the following terms :—(*a*) *Da Capo*; (*b*) *Dal Segno*; (*c*) *Staccato*.

3. (*a*) Play or sing from the beginning again; (*b*) Play or sing from the mark again; (*c*) Cut off—the notes marked are to be played or sung distinct from each other.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after,* **1st *May*, 1878; and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

FIRST PAPER.

Three hours and a half allowed.

Euclid.

MALES.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including Question 1, *if possible.*

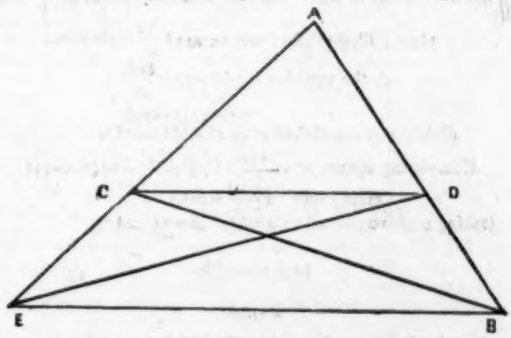
1. Give a triangle ABC and a point D in AB; construct a triangle ADE equal to ABC, and having the common angle A.

(Draw BE ∥ DC meeting AC at E; then △DCE = △DBC, etc.)

Because CD is ∥ BE, △ECD = △BCD, because they are on the same base CD, and between the same parallels DC, DE,

To each of these equals add the common △CAD; ∴ whole △ACB = whole △AED.

Wherefore △AED = △ACB, and it has the ∠A which is common to both.—Q.E.F.



2. If a straight line be divided into any two parts, the rectangle contained by the whole and one of the parts is equal to the rectangle contained by the two parts, together with the square on the aforesaid part.

Prop. 3, Bk. II.

3. To divide a given straight line into two parts, so that the rectangle contained by the whole and one of the parts shall be equal to the square on the other part.

Prop. 11, Bk. II.

Algebra.

MALES.

Answer two Questions.

1. Reduce to lowest terms—

$$3x^3+2ax(a+x)-a^3$$
$$3x^3+4ax(a+x)+a^3$$
$$3x^3+2ax(a+x)-a^3=\{x(a+x)+a^2\}(3x-a)$$
$$3x^3+4ax(a+x)+a^3=\{x(a+x)+a^2\}(3x+a)$$

∴ Dividing each term by the G. C. M. x^2+ax+a^2

the lowest terms are $\underline{\frac{3x-a}{3x+a}}$. Ans.

2. Solve the equations—

$$(1)\ \frac{3x-2a}{a-b}-\frac{2x-3a}{a+b}=1.$$

$$(2)\ \left.\begin{aligned}\tfrac{1}{2}\left(\cdot7x-\frac{6y}{7}\right)&=\cdot7\\ \cdot8y-\frac{5x}{8}&=-\cdot8\end{aligned}\right\}$$

$$(1)\quad \frac{3x-2a}{a-b}-\frac{2x-3a}{a+b}=1$$

Clearing of fractions,

$$3ax-2a^2+3bx-2ab-2ax+3a^2+2bx-3ab=a^2-b^2$$
$$ax+a^2+5bx-5ab=a^2-b^2$$
$$ax+5bx=a^2-a^2-b^2+5ab$$
$$x=\underline{\frac{b(5a-b)}{a+5b}}\text{ Ans.}$$

$$(2)\ \tfrac{1}{2}\left(\cdot7x-\frac{6y}{7}\right)=\cdot7 \text{ or } \tfrac{7}{10}x-\tfrac{3}{35}y=\tfrac{7}{10}$$
$$\cdot8y-\frac{5x}{8}=-\cdot8 \text{ or } \tfrac{4}{5}y-\frac{5x}{8}=-\tfrac{4}{5}$$

(Multiplying 1st equation by 280) $49x-60y=196$

(,, 2nd ,, 80) $64y-50x=-64$

(Again multiplying by 50)

1st equation becomes $2450x-3000y=9800$

(Again multiplying by 49)

2nd equation becomes $-2450x+3136y=-3136$

by addition $136y=6664$

$$\underline{y=49}.\text{ Ans.}$$

And ∴ $\underline{x=64}$. Ans.

3. A man bought cloth for £3 12s., and having sold it at 3s. 6d. a yard, he gained as much as 4 yards cost him. How much did he buy?

Let x = number of yds. Then $\frac{72}{x}$ = price of yd. in s.

$3\frac{1}{2}x$ = selling price of whole; and $\frac{72}{x}\times4$ = gain.

∴ the equation is $3\frac{1}{2}x-72=\frac{288}{x}$

$$7x^2-144x=576$$

dividing by co-efficient of x, $x^2-\frac{144}{7}x=\frac{576}{7}$

Completing square $x^2-\frac{144x}{7}+(\frac{72}{7})^2=\frac{576}{7}+\frac{5184}{49}=\frac{9216}{49}$

taking root $x-\frac{72}{7}=\pm\frac{96}{7}$

(taking positive root of x) $x=\frac{72}{7}\pm\frac{96}{7}=\underline{24}$. Ans.

Mensuration.

MALES.

Find the diameter of a gold coin which is equal in value to two other gold coins of the same thickness, whose radii are ·7 inch and ·3 inch respectively.

sq. in.

$\cdot7^2\times3\cdot1416=1\cdot539384$ area of one coin.

$\cdot3^2\times3\cdot1416=\cdot282744$,, other coin.

$1\cdot822128$ area of large coin.

$$\sqrt{\frac{1\cdot822128}{3\cdot1416}}=\sqrt{\cdot58}=\cdot7615 \text{ radius of large coin.}$$

∴ the diameter required $=\cdot7615\times2=\underline{1\cdot523}$. Ans.

Arithmetic.

FEMALES.

1. At 2½ per cent. per annum, find the sum of the interest on £80 for 2¼ years, and on £375 for 3½ years.

(*a*) Interest on £80 for 2¼ years at £2½ p. c.

$$=\frac{£80\times2\frac{1}{4}\times2\frac{1}{2}}{100}$$

,, ,, ,, $=\frac{£80\times9\times7}{1200}$

,, ,, ,, $=\frac{£1680}{400}=\underline{£4\ 4s.}$

(*b*) Interest on £375 for 3½ years at 2½ p. c.

$$=\frac{£375\times3\frac{1}{2}\times2\frac{1}{2}}{100}$$

,, ,, ,, $=\frac{£375\times16\times7}{5\times3\times100}=\underline{£28.}$

Sum of (*a*) and (*b*) = (£4 4s. + £28) = £32 4s. Ans.

2. What would be the difference between the annual incomes from the investment of £3450 in the 4 per Cents. at 92, and from the investment of the same sum in the 3½ per Cents. at 69?

(*a*) 92 : £3450 :: £4 : income from 1st investment.

$$\frac{£4\times£3450}{92}=\underline{£150}$$

(*b*) 69 : £3450 : £3½ : income from second investment.

$$\frac{£3\frac{1}{2}\times£3450}{69}=\underline{£166\ 13s.\ 4d.}$$

Difference of incomes = (£166 13s. 4d. − £150)

= £16 13s. 4d. Ans.

3. A person sold 72 yards of cloth for £8 14s., his profit being the cost of 11·52 yards. How much did he gain per cent.?

72 : 100 :: 11·52 : gain per cent.

$$\frac{11\cdot52\times100}{72}=\underline{16.}\text{ Ans.}$$

4. What is the discount on £257 8s. 8½d. for 210 days at 4½ per cent.? Explain the difference between discount and interest.

Interest on £100 for 210 days at 4½ p. c. $=\frac{210\times4\frac{1}{2}}{365}=\frac{189}{73}$

Amount ,, ,, ,, ,, $=100\frac{189}{73}$

∴ $102\frac{189}{73}$: $\frac{189}{73}$ :: £257 8s. 8½d. : discount.

$$\frac{£257\ 8s.\ 8\frac{1}{2}d.\times189}{7489}=\frac{247137\text{ fars.}\times189}{7489}$$

$$=33\text{ fars.}\times189$$

$$=6237\text{ fars.}=\underline{£6\ 9s.\ 11\frac{1}{2}d.}\text{ Ans.}$$

In discounting bills, bankers and merchants calculate *interest* instead of discount, on the sum drawn for in the bill, from the date of their discounting it to the time when it becomes due. *This discount* is greater than the *true discount* by the interest on the latter for the time that the bill has still to run.

5. Three persons, A, B, and C, purchased a ship. A paid for ⅓, B for ⅖, and C paid £400. What part of the ship had C, and how much did A and B pay?

(*a*) A pays for ⅓ or $\frac{15}{45}$ of the whole.

B ,, ,, ⅖ ,, $\frac{18}{45}$,,

∴ C pays for $\frac{45-37}{45}$ or $\underline{\frac{8}{45}}$ Ans.

(*b*) Now since $\frac{8}{45}$ cost £400 ∴ $\frac{1}{45}$ cost £50.

And hence A pays £50 × 10 or £500. Ans.

,, ,, B ,, £50 × 27 ,, £1350. Ans.

Grammar.

MALES AND FEMALES.

1. 'It was not by vile loitering in ease
That Greece obtained the brighter palm of art,
That soft yet ardent Athens learned to please,
To keen the wit and to sublime the heart,
In all supreme, complete in every part.
It was not thence majestic Rome arose
And o'er the nations shook her conquering dart:
For sluggard's brow the laurel never grows;
Renown is not the child of ignorant repose.'

THOMSON.

(*a*) Paraphrase this extract.

(*b*) Say how many sentences there are in the passage, and which of them is principal and which of them subordinate.

(*a*) Indolence and self-indulgence would have prevented Greece from taking the foremost place in painting, sculpture, and architecture. The luxurious but fiery Athenians by giving themselves up to the same enervating habits would never have succeeded in astonishing the world by their perfection in philosophy, poetry, law, and history; nor would the Romans ever have become the conquerors of the world. Sloth is almost synonymous with failure, and obscurity is the fate of him who spends his days in idle dreaming.

(*b*) There are eight sentences:—

1. 'It was not by vile loitering in ease' (principal).
2. 'That Greece obtained the brighter palm of art' (subordinate).
3. 'That soft yet ardent Athens learned to please . . . part' (subordinate).
4. 'It was not thence' (principal).
5. '(That) majestic Rome arose' (subordinate).
6. 'And (that she) o'er the nations shook her conquering dart;' (subordinate).
7. 'For sluggard's brow the laurel never grows' (principal).
8. 'Renown is not the child of ignorant repose' (principal).

2. What is the difference between literal and figurative language? Give any examples from this verse of the use of figures of speech.

Figurative speech or language is a deviation from the plain and ordinary mode of speaking (which is the literal) with a view to greater effect; thus when we say, 'The soldier is brave,' we speak literally; but when we say, 'The soldier is a lion,' we speak figuratively. 'Greece' and 'Athens' in the verse are used for the Greeks and Athenians, and 'Rome' for the Romans. This figure gives the *container for the thing contained*, and is called 'Metonymy.' Personification is a figure in which inanimate objects are spoken of as acting like, or having the qualities of, living beings, as when it is said that '*Renown* is not the *child* of ignorant *repose*,' and '*Rome* shook her *conquering dart*.'

3. How do you account for the introduction of many French words into our language? Say how you know such words when you see them, and give ten examples.

The Norman invasion of 1066 had a great effect on the English language, for by that event French became the language of the court, of the nobility, of the clergy, of literature, and of all who wished for or sought advancement in church or state.

To the Normans we owe most of the terms relating to—

(1) feudalism and war, (2) the church, (3) the law, and (4) the chase.

Examples (1) Aid, arms, assault, banner, fief, march, vassal.
(2) Altar, Bible, baptism, ceremony, preach, relic.
(3) Assize, attorney, fee, judge, jury, parliament.
(4) Bay, brace, mews, quarry, reynard, venison.

Geography.

Answer either Q. 2 or Q. 3, not both.

1. Give notes of a lesson on the Bay of Fundy, describing its situation, and its peculiar tides. Draw a map in illustration.

NOTES ON BAY OF FUNDY.

SITUATION.—Fundy Bay is one which extends 150 miles between Nova Scotia and New Brunswick, in the Dominion of Canada. It opens to the south, and is separated from the Atlantic on the east by the peninsula of Nova Scotia.

TIDES.—On account of this bay opening broadly and narrowing inwards, the waters of the tidal wave are prevented from spreading in a sidelong direction, and being cooped up, the wave, which in the open ocean is only from three to eight feet in height, is raised to a height of from 20 to 70 feet. Similarly, at the mouths of rivers, where the water is shallow or the channel narrow, the waters of the tide accumulate into a high mass termed a *bore*, which rushes up the river with impetuous force.

Other examples are found in the British Channel, the Tsientang in China, and the Amazon in South America. On the opposite coast of Nova Scotia, at Halifax, the spring tides do not exceed even at the equinoxes six or eight feet; while in the Bay they have been known to rise to 70, 80, and even 100 feet.

2. Describe fully the islands of the Pacific Ocean.

Oceania is a name given to that division of the globe which comprises all the islands and archipelagos in the Pacific. It is usually divided into four sections, which are pretty well defined, not only by their geographical position, but also by their physical characteristics. These divisions are (1) Australasia, or Melanesia, comprising Australia, New Guinea, and New Zealand, with their smaller islands; (2) Malaysia, or Indian Archipelago, comprising numerous islands and archipelagos, from Australia and New Guinea as far as Further India and China; (3) Micronesia, consisting of numerous small islands lying north of the equator and east of the Malay Archipelago; (4) Polynesia, or the South Sea Islands, comprising the numerous archipelagos in the South Pacific east of Australasia.

To the north of the equator the islands and groups, though numerous, are much less so than to the south of the line. The first division, viewed as a whole, is characterised by a very spare population, by few rivers, by sandy deserts, and by singular animal and vegetable productions. The second division is divided into seven groups, which are more or less of volcanic origin, and exhibit at the present time many active volcanoes in numerous localities. The islands of the third division, with the exception of Hawaii in the Sandwich group, are all of moderate elevation, and either of coralline construction or surrounded by coral reefs. The climate is healthy and agreeable, being tempered by cool breezes, and the vegetation is gorgeous in the extreme. The fourth division is almost similar to the third in respect of general features and productions, the latter comprising bread-fruit tree, cocoa-nut palm, banana, plantain, sugar-cane, taro root, and numerous other edible roots and fruits.

3. Compare the mountains and rivers of the different continents, pointing out the resemblances and the differences between them. Give illustrations, with exact figures as to heights of mountains and lengths of rivers.

The Old World, comprising Europe, Asia, and Africa, may be looked upon as one great continent, through the entire length of which runs a line of mountains and high ground. Beginning on the shores of the Atlantic, in the Atlas and Pyrenees, this line continues through the Alps and Carpathians, the Caucasus, and the range of Elburz to the Hindoo Koosh, and the high plateau of Pamir, which, 15,000 feet high, bars the direct road between east and west. It passes thence to still higher tracts in Tibet, great plains exceeding in height the highest summits of the Alps, enclosed between the lofty ramparts of the Himalayas on the south and the Kuen-lun mountains on the north; and thence the mountain wall is prolonged in the range of Yuen-ling, In-shan, and Stanavoi, till it passes to the Pacific at Behring's Strait.

Turning to the New World, which comprises North and South America, we find the mountains, instead of running east and west, ranged close to one of the coasts, and running almost directly north and south. Instead of the centre of this continent being occupied by a great mass of highlands almost impossible to climb, and, when reached, quite shut off from the rest of creation, the mountains of America are mostly ranged close to the west coast, and its lowlands abound in splendid rivers, which form natural roads to every part of the country. In South America the Andes run close along the western coast at an average height of 11,000 feet, with numerous peaks varying from 16,000 to 24,000 feet in height. At the Isthmus of Panama they are interrupted, but immediately start again, and, under the name of the Rocky Mountains, run on still northerly till they end on the shore of the Arctic Ocean after an unbroken course of over 8,000 miles.

The rivers of America are the largest in the world, not only for their length and volume of water, but for the extent of their basins. In South America, three rivers—the Orinoco, the Amazon, and the La Plata—take three-quarters of the whole drainage of the country to the Atlantic. These rivers, rising near one ocean, run thousands of miles to fall into another. In the Old World we find a resemblance to this, though on a smaller scale, in the Po, in Italy, and also in the Murray of Australia. In North America the Mississippi and Missouri receive much of their drainage from the Rocky Mountains, and run a longer course than even the Amazon.

The rivers of Europe, though far behind those of Asia for size, are far before them for convenience and advantage.

Both in the Old World and the New there are river basins without any outlet to the ocean. In the former there are the basin extending from the Valdai Hills to the Plateau of Mongolia in Asia, the basin of the Jordan, and the basin of Lake Chad, in Africa; in the latter the great basin in the middle of the plateau of the Rocky Mountains in North America, and the basin of

Lake Titicaca in South America; and in Australia there are the basins of Lakes Torrens, Gairdner, etc.

COMPARATIVE TABLE OF RIVERS AND MOUNTAINS.

Rivers.	Continent.	Length in Miles.	Mountains.	Continent.	Height in feet.
Mississippi } Missouri }	N. America	4,150	Mt. Everest	Asia	29,002
Amazon	S. America	4,000 (?)	Aconcagua	S. America	23,910
Nile	Africa	4,000 (?)	Kilimandjaro (?)	Africa	20,065
Yangtse	Asia	3,200	Mt. St. Elias	N. America	17,900
Volga	Europe	2,400	Mont Blanc	Europe	15,781

SECOND PAPER.

Two hours and a half allowed.

Arithmetic.

MALES.

1. A walks nine steps in five seconds, and B five steps in three seconds, but eleven of B's steps are equal to twelve of A's. Compare their rates of walking.

(*a*) In 5 sec. A takes 9 steps. (*b*) In 3 sec. B takes 5 steps.

∴ ,, 15 ,, ,, ,, 27 ,, ∴ ,, 15 ,, ,, ,, 25 ,,

That is, A takes 27 while B takes 25,

But A's step is only $\frac{11}{12}$ of B's;

∴ A's rate is to B's as $27 \times \frac{11}{12} : 25$

,, ,, $\frac{297}{12} : 25$

,, ,, $297 : 300$

i.e., $\underline{99} : \underline{100}$. Ans.

2. A shopkeeper bought goods, and retailed one-half at a gain of 10 per cent., and the rest at a gain of $12\frac{1}{2}$ per cent., and his total gain was £67 10s. What did the goods cost?

$$\text{Average gain p. c.} = \frac{10 + 12\frac{1}{2}}{2} = 11\frac{1}{4}$$

∴ $11\frac{1}{4} : 67\frac{1}{2}$ :: £100 : cost required.

$$£100 \times \frac{67\frac{1}{2}}{11\frac{1}{4}} = £100 \times \frac{270}{45}$$

$$= \underline{£600}. \quad \text{Ans.}$$

3. Find $\sqrt{\frac{4}{9}\frac{4}{9}\frac{4}{9}}$ and $\sqrt{\frac{.64}{.4}}$

$$\sqrt{\frac{4}{9}\frac{4}{9}\frac{4}{9}} = \sqrt{\frac{4}{9}\frac{4}{9}} = \underline{\frac{4}{9}}. \quad \text{Ans.}$$

$$\sqrt{\frac{.64}{.4}} = \sqrt{\frac{.64}{\frac{4}{10}}} = \frac{.8}{\frac{1}{2}} = \frac{2.4}{2} = \underline{1.2}. \quad \text{Ans.}$$

4. What must be the price of 4 per cent. debentures, if by investing £4250 in them a man gets a net dividend of £132 12s., after deducting an income tax of 6d. in the £, a brokerage of $\frac{1}{8}$ being charged?

(*a*) 19½s. : 20s. :: £132½ : dividend before deducting the tax.

$$£132\tfrac{1}{2} \times \frac{20}{19\frac{1}{2}} = £\tfrac{265}{2} \times \tfrac{2}{39} = £136.$$

(*b*) £136 : 4 :: £4250 : price per cent. + brokerage.

$$\frac{£4250 \times 4}{136} = \underline{£125} \quad \therefore \text{ deducting } \tfrac{1}{8} \text{ the price} = \underline{£124\tfrac{7}{8}}. \quad \text{Ans.}$$

5. A man insured a ship to ¾ of its value at 6s. 8d. per cent. The ship was lost, and the owner was £2990 worse off than if he had insured the ship to its full value. What was the ship worth?

By keeping off £½ per cent. he loses ¼ of the ship; that is, if he had paid £½ per cent. of the ¼, he would have had 99¾ out of every 100 of the ¼.

∴ 99¾ : 100 :: £2990 : the fourth part.

$$£2990 \times \frac{100}{99\frac{3}{4}} = \frac{£2990 \times 300}{299}$$

$$= £3000$$

∴ the ship is worth £3000 × 4 = £12,000. Ans.

History.

MALES AND FEMALES.

1. How is it that the Orkney and Shetland Islands are attached to the British crown?

By the marriage of James III. of Scotland with the Princess Margaret of Denmark, he obtained a grant of the islands of Orkney and Shetland. They continued a possession of the Scottish crown until the union of the crowns in 1603, when they became attached to the British crown.

2. The Declaration of Rights is described as a contract between sovereign and people. How was it prepared, what are its contents, and by whom was it ratified?

This declaration was handed to and ratified by William III. and Mary II., when the crown of England was formally given to them.

It declared the illegality of suspending laws, levying taxes, or of maintaining a standing army in times of peace without the consent of Parliament. It declared that such courts as the High Commission and Star Chamber are unlawful; that subjects have a right to petition the sovereign; that Parliamentary elections are free; that freedom of speech ought not to be called in question out of Parliament; that the sovereign must not be a Roman Catholic, nor married to a Roman Catholic; that juries must be selected impartially; that grants of fines or forfeitures before conviction are illegal; that judges do not hold their office at the royal pleasure; and that Parliament should meet frequently for the redress of grievances.

3. What is meant by the Legislative Union of England and Scotland? When and how was it effected? Describe the condition of Scotland at that period.

By the Legislative Union of England and Scotland is meant that Act of Parliament passed in the reign of Anne (1707) to draw the two countries closer. In July, 1706, the articles of Union were agreed upon by the Scotch and English Commissioners, were enacted by the English Parliament, and, after strong opposition from the lower classes in Scotland, especially from the Presbyterians of the west of Scotland, passed the Scotch Parliament by a large majority in January, 1707. On May 1st, 1707, the Act of Union came into force, and the two kingdoms were made one then and for ever after under the name of Great Britain. English gold is said to have been a potent means in obtaining Scottish votes.

Scotland at that time was a poor country, a fact sufficiently attested by the land tax of the whole kingdom being fixed at little more than half the land tax of the single county of Norfolk. At the time of the Darien scheme, a few years before the Union, Macaulay says 'that a great part of Scotland was as poor and rude as Iceland is now. There were five or six shires which did not altogether contain so many guineas and crowns as were tossed about daily by the shovels of a single goldsmith of Lombard Street. Even the nobles had very little ready money. They generally took part of their rents in kind, and were thus able to live on their estates plentifully and hospitably. But there were many esquires of Kent and Somersetshire who received from their estates a greater quantity of gold and silver than a Duke of Gordon or a Marquess of Atholl drew from extensive provinces. Four hundred thousand pounds probably bore as great a ratio to the wealth of Scotland then as forty millions would bear now.'

Teaching.

Show in what way and by what examples you would explain to children the difference between an adjective and an adverb.

Since adjectives qualify nouns only, and adverbs modify the meaning of verbs, adverbs, and adjectives, it will first be necessary to give the children a clear notion of the meaning and use of the adjective.

Introduce the subject by asking for the names of things that the children would like, and they will probably answer, 'apple,' 'orange,' 'watch,' 'doll,' etc. Then question them as to what kind of apple, etc., they would like, and they may say, 'good,' 'large,' 'ripe,' etc. Proceed in the same way as to the kinds they would *not* like, and 'bad,' 'sour,' etc., will be given. Then question as to *how many* oranges, etc., they would like, which will illustrate adjectives of quantity in the same manner as the questions above illustrated those of quality.

After making sure that all understand the use of the adjective in qualifying the *noun* itself, we may proceed to show that the adverb qualifies what the *noun does*; and that while adjectives

tell *what kind* of boys there are in a class, the adverb tells *how*, *when*, and *where* they may have done their work. For example, 'the diligent boy will always work diligently'; 'the greedy boy must have his big orange just now'; 'the boy walks lazily, rapidly, or steadily'; 'the girl looks eagerly, vacantly, or steadfastly'; 'they all work regularly, busily'; etc.

After uttering these sentences, or writing them on blackboard, ask for the words telling how the boy works, or walks, how the girl looks, and how they all work. The answers will easily be got, and the words, because showing modes of action, are 'adverbs.'

Exercises to show that the same word may often be used both as an adverb and as an adjective may be given—as, 'the *daily*, *weekly*, or *monthly* journal' (adjectives); and the 'Times' is issued *daily*, the PRACTICAL TEACHER *monthly*, and the 'Governess' *weekly* (adverbs).

Most of the adjectives of quality are easily transformed into adverbs by adding 'ly'; thus, *gladly*, *weakly*, *scornfully*, *basely*, are adverbs formed from *glad*, *weak*, *scornful*, *base*.

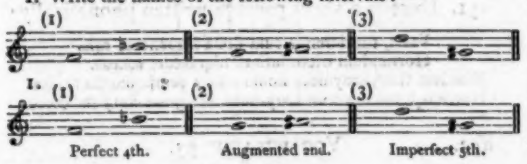
Music.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

STAFF NOTATION.

1. Write the names of the following intervals:—



2. Write before the notes the sharps essential to the scale of E minor, using the minor sixth and the major seventh.

3. Explain the following terms:—(1) *Allegretto*; (2) M. 90; (3) *Dolce*.

3. (1) Rather merry, not so fast as *allegro*; (2) M. 90. means that every beat is to occupy the 90th part of a minute; (3) Sweetly.

TONIC SOL-FA NOTATION.

1. What is the interval (*a*) between *fah* and *ta*; (*b*) between *doh* and *re*; (*c*) between *doh*' and *fe*?

1. (*a*) Perfect fourth; (*b*) Augmented second; (*c*) Imperfect fifth.

2. In the minor mode (*a*) what is the essential Sixth, and (*b*) what is the essential Seventh?

2. (*a*) A *minor* sixth, (*b*) a *major* seventh.

3. Explain the following terms:—(*a*) *Allegretto*; (*b*) M. 90; (*c*) *Dolce*.

3. (*a*) Rather merry, not so fast as *allegro*; (*b*) The pulses of the tune are to move at the rate of 90 in a minute; (*c*) Sweetly.

Corrections in September issue.

P. 379, Euclid, No. 3.—Read for answer: 'Since the length of the third side must not be greater than 10 nor less than 2 feet (I. 20 and 22), therefore *nine*, etc.,' and delete '1 foot.'

P. 384, Arith., No. 3.—For '2½d.' read '6d.'

P. 386, ,, No. 2.—Delete $5\frac{11}{17}$, $5\frac{7}{17}$ and $\frac{12}{17}$; and read: Diff. of percentage bet. A and B $= \frac{850}{17} - \frac{1020}{200} = \frac{50}{100}$. Ans.

Lessons in Latin.

BY THE REV. A. D. CAPEL, M.A., CANTAB.,

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KEY TO EXERCISES.

EXERCISE 29.

A.

1. It is disgraceful to break one's word. 2. It is easy to keep one's word. 3. All men are loved by their sons. 4. All men must labour. 5. On account of which thing he is condemned to death by the dictator; but is freed by the great favour of the soldiers. 6. The Samnites conquered the Romans at the Caudine Forks, with great disgrace, and sent them under the yoke. 7. Wealth is deservedly envied by a brave man (lit., an object of envy to a brave man), because the rich man with his chest intercepts the true praise. 8. I have received a sad letter, which you wrote to me. 9. The Romans raised a huge statue to Romulus. 10. The stag fled from the instant destruction of the hunters.

B.

1. Facile est epistolam scribere. 2. Afri ingentem statuam Hamilcari posuerunt. 3. Mors tristis dicitur a milite. 4. Omnes sub jugum mittuntur. 5. Dulce est æstate in gramine jacere. 6. Pyrrhus, quem consul sua manu vulnerat, fugit Tarentum. 7. Tum Romani omnes captivos, quos Pyrrhus reddiderat, redire jusserunt. 8. Medicus Valerii ad Fabricium nocte venit, et eum occidere promisit. 9. Hiero cum omnibus hominibus a Romanis pacem petierunt. 10. Pugnandum est fortiter pro patriâ.

EXERCISE 30.

A.

1. We are loved by God. 2. I am advised not to go down to the water (that I should not). 3. We are ruled by a gentle queen; therefore let us fight for our country. 4. We who loved our country are being butchered by our fellow-citizens. 5. I who saved my mother shall be killed by my brothers. 6. We must labour that the work may be finished. 7. We are taught by good masters; therefore let us learn. 8. The consuls destroyed the Samnites in great battles. 9. We must run that we may not be destroyed by the tempest. 10. Let us live on this side of the Alps that we may not be harassed by our enemies.

B.

1. A Samnitibus vincebamur quum Dictator pervenit. 2. Discendum est ut a magistro laudemur 3. Jucundum est vivere, quum ab omnibus amamur. 4. Quis, præter parentes, nos amat, quum vexamur? 5. Oppidum est magnum, non inveniemur intra muros. 6. Dux militibus dixit, pugnandum est non fugiendum. 7. Milites dixerunt non fugiemus. 8. Postea ad regem ducebamur ut interrogaremur. 9. Virum cano qui primus a Trojæ littoribus ad Italiam venit. 10. Leonum ora impune a magistribus tractantur.

EXERCISE 31.

A.

1. One is a Roman, the other an Alban. 2. Some of the Romans were dying of disease, others were being drowned in the river. 3. Of the Alban brothers no one was preserved, but of the Roman brothers one departed from the battle as a victor. 4. Neither of my parents is alive. 5. It is one thing to learn, another to teach. 6. Which of the two do you love? 7. He is a true friend who loves others (when) oppressed. 8. Now others must fight; to-morrow again we must fight. 9. He did nothing for anybody. 10. No one is the son of nobody; all men have parents.

B.

1. Aliis magni, alii parvi sunt. 2. Homo unius patris et unius matris filius est sed multos majores habet. 3. Quis dolorem videt sine lugendo? 4. Unus ex pueris per urbem cucurrit, alter in gramine jacuit. 5. Omnes pueri in flumine mergebantur quum pater eos servavit. 6. Aliud est petere, aliud habere. 7. Puerorum ora cibo implentur. 8. Amici utrius libros puero non dabo. 9. Pueri, uni magistro, quem amant, sed non alteri, qui est severus, laborabunt 10. Omnes discamus pugnare pro patriâ ut pacem habeamus.

EXERCISE 32.

A.

1. You have done many things which hurt your mother. 2. The river, which flows into the ocean, is large. 3. Must not all boys play sometimes? 4. The master, who slew his slave, will be butchered to-morrow. 5. In the times of Cæsar, the soldiers did not fight in the winter. 6. Let us learn our lessons with all zeal. 7. He made peace with the Tuscans, and built a temple to Jupiter. 8. Soon the army also left Tarquin, who, with the king, was besieging the city of Ardea. 9. After four years the Africans rebelled. 10. It is easy to run through the meadows.

B.

1. Magnus anguis per murum serpsit. 2. Mea dictata didici. 3. Humanum est liberos suos juxta urbem sepelire. 4. Cæsar hostes vicit. 5. Fabium, ne pugnaret, jussit. 6. Altos hostium clamores audit. 7. Ingentem statuam Hannabali posuit. 8. Multa et magna templa in capitolio ædivicavit. 9. Auctumno anni messem metimus. 10. Sororem tuam vexavisti.

EXAMINATION QUESTIONS No. 4.

1. A relative is a conjunction and a personal pronoun compounded into one word. 2. A cæsura in a verse is a division into two parts, which almost always takes place after the 1st syllable of the 3rd foot. 3. No cæsura can take place after the 1st syllable of the 5th foot. 4. By adding 'ur' or 'r,' or changing the last letter into 'r.' 5. If the neuter singular of I adjectives ends in 'e,' the abl. sing. ends in 'i' only.

(*a*) In 'The son of Cæsar,' the 'of' shows that 'Cæsar' limits 'son,' and that it must be in the gen. case.

(*b*) In 'One of them,' etc., the 'of' is equal to 'out of,' and must be expressed by 'ex' with abl.

(*c*) In 'I am thinking of,' etc., the 'of' is a part of the verb, which is followed by acc. case.

(*d*) In 'He said it of me,' 'of' here is equal to 'concerning,' and must be expressed by 'de' with the ab.

(*e*) In the 'City of Rome,' the Latins say the 'City Rome,' and put both words into the case 'city' is in, since they refer to the same thing.

LESSON XXXIII.

MODERN PRONUNCIATION.

246. The vowels are all pronounced as the Italian vowels—that is 'a,' as 'a' in father, 'e,' as 'a' in hay, 'i' as 'e' in 'the.'

247. All the 'c's are pronounced as 'k's.

248. Ae is pronounced as 'a' in hay.

249. All the 'v's are pronounced as 'w's.

250. The 'j's are not only pronounced as 'i's, but very often so printed; 'v's too are sometimes printed as 'u's.

251. Here is a short passage written phonetically:

Vidit, thuricremis cum dona imponeret aris.
Horrendum dictu latices nigrescere sacros.
Weedeet thurykraymees koom donar eemponarate ar-ees.
Horranedoom deectoo larty-kase nee-grase-kary sar-crose.

252. VOCABULARY 33.

English.	*Latin.*		*Derivative.*
Hundred	Centum (indec.)		Per cent
Immediately	Extemplo, an adv.		
Suddenly	Subito, an adv.		
Æneas	Æneas (a decl., acc. Æneam)		
To loosen	Solvĕre	P. R. Solv	Solution
Cold	Frigus	Frigŏre, n. g.	Frigid
Limbs	Membra (no sing. o decl.)		Members
To drip	Mānāre	R. Man	Emanate
Sweat	Sūdor	G. Sudōris	Sudorific
Now	Jam ('now' of Hist. not of present time), conj.		
To proceed / To advance	Prŏcēdĕre	P. R. Process	Procession
And	Atque or ac. (used only to couple clauses)		
To stand / To stand still	Constare or Stare	P. R. Constit / P. R. Stet	Constitution / Station
Ally	Socius	G. Socii	Social
	m. f. n.		
Unknown	Ignotus -ta -tum	R. Ignot	
Joyful	Lætus -ta -tum	R. Lœt	
Serene / Quiet	Sērēnus -na -num	R. Seren	Serenity
Your (pl.)	Vester -ra -rum	R. Vestr	
Divine	Divinus -na -num	R. Divin	Divinity
New	Nŏvus -va -vum	R. Nov	Novelty
Last	Ultĭmus -ma -mum	R. Ultim	Ultimatum
Bad	Mălus -la -lum	R. Mal	Malice
Poison	Vēnēnum	G. Veneni, n. g.	Venom
Form	Forma	G. Formæ	Formal
Lamb	Agnus	G. Agni	
Why?	Cur? (interrogative adv.)		
Drinking	Haustus	G. Haustus	Exhaust
To disturb	Turbare	R. Turb	
To abuse / To injure	Mălēfăcĕre	P. R. Malefĕc	Malefactor
To laugh at	Rīdēre	P. R. Ris	Risible
To bring forth	Părĕre	P. R. Pĕpĕr	Parturition
Ago	Ante, adv.		
To eat	Edĕre	P. R. Ed	Edible
Always	Semper, an adv.		
Reason	Rātio	G. Ratiōnis	Rational
To avoid	Vītare	R. Vit	Inevitable

253. EXERCISE 33.

A.

All the sentences in this exercise are extracted from Virgil (the termination 'erunt' being substituted for the poetic form 'ere'), which in future will be designated by a V being inserted after such an extract.

Where Latin and English names are similar they will be omitted in the Vocabularies. Countries, etc., in 'a' are A nouns. Names in 'us' are 'O' nouns. Proper names in 'O,' as Cicero, form their roots by adding 'n,' and those in consonants generally have a a root similar to the noun, as Hamilcar, G. Hamilcaris, root Hamilcar. All such names belong to the I decl. Other names will be given fully in the Vocabularies.

1. Extemplo Æneæ solvuntur frigore membra. 2. Centum urbes (7) habitant (18) magnas (20). 3. Nox (29) est, et terris (8) animalia (27) somnus (17) habebat (7). 4. Tum (20) gelidus (26) toto (31) manabat corpore (15) sudor. 5. Jamque dies (8) alterque (31) dies processit. 6. Atque hæc (Eng. *these things* acc.) deinde (19) canit (30) divino ex (26) ore (30) sacerdos (18). 7. Effigiem (22) Xanthi Trojamque (30) videtis (27) quam vestræ fecerunt (31) manus (8). 8. Postquam (17) cuncta (27) (understand *things*) videt (27) cœlo (27) constare sereno. 9. Italiam læto socii clamore (13) salutant (2). 10. Subito e (26) silvis (11) ignoti nova forma viri (18) procedit.

B.

1. A wolf (8) and a lamb were standing (use stare) near (9) a river (5). 2. The wolf said (15) to the lamb, Why do you disturb my (20) drinking? 3. The lamb answered (Latin contra indecl.), I am not disturbing your drinking. 4. The wolf said, Last year (17) you insulted me (Latin, mihi). Then (19) the lamb laughed at the wolf and said, My (20) mother (14) had not then (20) brought me (Lat., me) forth. 6. The wolf then (19) said, Many (20) years (17) ago your (20) father (14) abused me (Lat., mihi). 7. The lamb said nothing (31). 8. The wolf killed (30) the lamb and ate (6) (it). 9. A bad man (5) will always find (28) a reason for (Eng., of) a bad (act). Let us avoid bad men (5) as (Lat. ut) poison.

EXERCISE 34.

The Second Persons of Passive Voice.

254. The second persons singular of passive tenses formed with the present root end in 'ris,' and are formed from active forms by inserting 'ri' before the final 's,' as amas, amaris.

255. The second persons plural of passive verbs, formed with present root, end in 'mini,' and are formed from active forms by changing 'tis' into 'mini,' as amatis, amamini.

256. Now we know all the active and passive forms of verbs of the indicative and subjunctive moods, except those parts of the passive verbs which correspond to the active forms, formed with the perfect root.

257. These tenses in the passive voice, as in French, are compound tenses, formed with the perfect participle and the tenses of esse (Eng., to be). These will be discussed in future lessons.

258. VOCABULARY 34.

English.	*Latin.*		*Derivative.*
Star	Sĭdus	G. Sideris, n.g.	Sidereal
To raise	Tollĕre	P.R. Sustul	
Trojans	Dardănĭdæ, no sing. A decl.		
Shield	Clўpeus	G. Clypei	
	m. f. n.		
Left (not right)	Sinister-tra-trum	R. Sinistr	Sinister
To raise aloft	Efferre	P.R. Extul	Elate
	m.f.n.		
Shining	Ardens, I decl.	R. Ardent	Ardent
To snatch up	Corripĕre	P.R. Corripu	
Spear	Hasta	G. Hastæ	
To deceive	Dēcĭpĕre	P.R. Decipu	Deception
Even	Etiam, adverb		

259. EXERCISE 34.

A.

1. Vos (Eng. 'you'), O pueri (7), a parentibus (11) amamini (2). 2. A civibus (8) Cæsar, amaris (2). 3. A reginâ (8) regemini (4) quum (a conjunction) rex (8) perierit (26). 4. Tu (Eng. 'you') qui (30) ab omnibus (29) timeris (16) nunc (27) caperis (26). 5. Romam puerum (7) mittes (5), ut Latinam linguam (22) doceatur (3). 6. Nonne patris (35) tui (20) precibus (35) retineberis (18). 7. Clamorem (3) ad sidera tollunt, Dardanidæ e (26) muris (9) V. 8. Clypeum tum (20) deinde (Eng. 'next') sinistra (supply 'hand') extulit ardentem V. 9. Vos, O pueri (7), qui (30) recitata (12) non recitatio (14) verberabimini (16). 10. Tum (20) magnam (20) corripit hastam et jacit (4).

B.

1. You (exp. as in A. 1), O parents (11), are being deceived by your (33) children (11). 2. Even now (33), O general (2), (thou) art not conquered (23). 3. Will (you) (sing.) not free (12) your (20) slave (7), that (20) you may be praised (2). 4. I have returned (27) to Rome that (you) may be punished (6). 5. All (29) men (5) must eat (6) that they may live (6). 6. I came (19) to Rome in order that I might not (note not 'ut non') be killed (30). 7. My (20) father (14) and mother (14) are living (6) in Africa. 8. You (pl.) are feared (3) by your fellow-citizens. 9. No one (17) must run (26) through the city (7). 10. It is easy (29) to live (6) well (21) when (13) men (5) love (2) us (Lat. nos.)

LESSON XXXV.

PERSONAL AND REFLEXIVE PRONOUNS.

260. The Personal pronouns are very irregular in Latin as in all other languages.

261. The third personal pronoun is really a reflexive pronoun, and can therefore only refer to the subject (when a third person) of the principal sentence.

262. The Latin for 'he, she,' etc., and their cases, when not referring to the subject of the sentence, is some demonstrative pronoun, which we shall discuss in the 37th lesson.

263. The reflexive pronoun is introduced here on account of its similarity in form to personal pronouns.

	1st Pers.	*Eng.*	*2nd Pers.*	*Eng.*	*Reflexive*	*Eng.*
			Sing.			
N.	Ego	I	Tu	Thou		(None)
Ac.	Me	Me	Te	Thee	Se	Himself
G.	Mei	Of me	Tui	Of you	Sui	Of himself
D.	Mihi	To me	Tibi	To you	Sibi	To himself
Ab.	Me	By me	Te	By you	Se	By himself

1st Pers.	Eng.	2nd Pers.	Eng.	Reflexive	Eng.
		Plural.			
N. Ac. Nos	We or Us	Vos.	You	Same	Themselves
G. Nostrum / Nostri	Of us	Vestrum / Vestri	Of you	as	Of Themselves
D. Ab. Nobis	To or By us	Vobis	To or By you	Sing.	To or By Themselves

264. When to use 'nostrum' or 'nostri,' etc., will be discussed in a future lesson, when we explain the difference between objective and subjective genitives.

265. VOCABULARY 35.

Eng.	*Lat.*		*Derivative.*
To raise up	Attollere	P. R. Attul	
Thigh	Fēmur	G. Femoris	Femoral
Hence	Hinc, adv.		
Harbour	Portus —	G. Portus	Port.
Foot soldier	Pĕdes	G. Pĕdĭtis	
Elephant	Elĕphantus	G. Elephanti	Elephantine
Line of battle	Acies	G. Aciei (E. decl.)	
To bear	Ferre	P. R. Tul.	
But	At, conj.		
To stand around	Circumstāre	P. P. Circumstĕt	Circumstance
Horror	Horror	Horrōris	
To be amazed	Obstupeo	P. R. Obstupu	
Threshold	Līmen	G. Līmĭnis	
To set	Sistere	P. R. Stit	Station
Blood	Sanguis	G. Sanguinis, m. g.	Sanguinary
All-powerful	Omnipotens, (adj.)	G. Omnipotentis	Omnipotent
Flight	Fŭga	G. Fugæ	Fugitive
Prayer	(No nom. sing.)	G. Precis	
To turn	Flectĕre	P. R. Flex	
Father	Gĕnĭtor	G. Genitōris	
	m. f. n.		
Holy	Sanctus -ta -tum	R. Sanct	Sanctify
Whole	Intĕger -gra -grum	R. Integr	Integral
Of one's country / Of one's father	Patricius -ia -ium	R. Patrici	
Safe	Salvus -va -vum	R. Salv	Salve
Fierce / Savage	Sævus -va -vum	R. Sæv	
Middle	Medius -ia -ium	R. Medi	Mediate
Sick	Æger -gra -grum	R. Ægr	
Sad	Mœstus -ta -tum	R. Mœst	
To detain	Dētĭnēre	R. Detinu	Detention
Shore	Ora	G. Oræ	
To adore	Adorare	R. Ador	Adoration
To fill	Implēre	P. R. Implēv	
Mother	Gĕnĭtrix	G. Gĕnĕtrĭcis	
Often	Sæpe, adverb		
Breeze	Aura	G. Auræ	

266. EXERCISE 35.

A.

1. Attollit in ægrum se femur. 2. Hinc Drepani (Eng., Drepanum, a sea-port of Sicily) me portus accipit (28) V. 3. Elephanti jam (33) in mediam peditum aciem se tulerant. 4. At me tum (20) primùm (20) sævus circumstetit horror, obstupui V. 5. Tutum patrio te limine sistam V. 6. Vos O, quibus integer vitæ (11) sanguis, vos agitate (hasten) fugam V. 7. Jupiter omnipotens, precibus et si (15) flectĕris ullis (31), aspice (Eng., look upon) nos V. 8. Genitor se tollit (35) ad auras et sanctum sidus (34) adorat V. 9. Implevi clamore (3) vias (11) mœstusque Creusam iterumque (20) iterumque vocavi (11) V. 10. Sed (6) me magna (20) Deûm (gen. pl. for Deorum) (27) genitrix his detinet oris V.

B.

1. The girl (8) hurt (4) herself with the needle (18). 2. The masters (13) whipped (16) you, O boys (7), because (7) you had not learnt (27) your lessons (12). 3. He told (15) me to depart (31). 4. Who (30) will not come (19) to hear (4) Cicero? 5. I have often heard Cæsar to say (15) (Eng, say), you must fight (10), O soldiers (6). 6. I hurt (4) myself much (20) with a sword (16). 7. All (men) (27) love (2) themselves. 8. Must not all men learn (27) to preserve (10) themselves? 9. We were being hurt (4) by you (pl.). 10. He is coming (19) to Rome in the winter (16).

(To be continued.)

—o—

Notes on Bacon's Essays.

BY FRANCIS WATT, M.A.

ESSAY XLV.—OF BUILDING.

SUBSTANCE.

IN building, convenience must be considered before beauty. The seat or situation is very important. We must not only ask is it good in itself, but what are its surroundings? The plan of a great house described at length.

Houses are built to live in and not to look on. It would have been well if the architects of some of our great public buildings had remembered this.

preferred before, preferred to.

uniformity, conformity to a pattern, consistence with itself.

enchanted palaces, the poets building houses with words only, may be permitted to study beauty alone.

seat, site; so Sir W. Raleigh. 'It remaineth now that we find out the site of Eden.'

air is unequal, in temperature.

you shall see. Again observe 'shall,' used in the second person merely to foretell. The modern use of 'shall' and 'will' is tolerably well distinguished in the following lines:—

> In the first person simply *shall* foretells,
> In *will* a threat, or else a promise dwells;
> *Shall*, in the second and the third, does threat;
> *Will* simply then foretells a future feat.

fine seats, here 'seats' mean 'mansions.'

knap, hillock, rising ground; connected with knob.

several, different, distinct from one another; so our author, in his 'Natural and Experimental History,' 'Divers sorts of beasts came from several parts to drink.'

ill ways, bad or difficult roads.

ill markets, difficulty of getting provisions.

Momus was the god of mockery and jest (Gr. *mōmos*, blame, censure). Perhaps there is some reference to the criticism Momus passed on Minerva's house, 'that it was not provided with wheels by which to remove it from the annoyance of ill neighbours.' The phrase, *if you will consult with Momus*, means, 'if you are careful as to the company you have about you.'

commodity, advantage; *discommodity*, disadvantage.

lurcheth, absorbs (Lat. *lurco*, a glutton). Note how good roads, railways, telegraphs, etc., have rendered many of the remarks in this essay curiously out of place.

scanted, limited, restricted. This will alter the suitability of a place or home for him.

sort them, arrange them.

he wanteth, lacks.

Lucullus, a very wealthy Roman of the first century B.C. He conquered Mithridates, a dangerous foe to the Romans in the East; but is chiefly known for the luxury in which his later years were past. The story is from Plutarch's 'Life of Lucullus.'

Pompey, the great Roman general, the ally, and finally the opponent of Cæsar, who crushed him at Pharsalia (B.C. 48). Pompey was murdered in Africa shortly after his defeat.

fowl, birds.

perfection, practice.

model, plan or map.

Vatican, the gigantic papal palace on the Mons Vaticanus, at Rome. It contains 4,500 apartments, and many noble chapels, halls, courts, staircases, etc.

Escurial, a royal palace of the kings of Spain at some little distance from Madrid. It is built in the form of a gridiron, in honour of St. Lawrence, in whose martyrdom a gridiron was used. It consists 'of a palace, forming the handle of the gridiron, a convent, two colleges, three chapter houses, and three libraries. It contains 35 great halls, 80 staircases, and has more than 4,000 windows.'

fair, fine.

several sides, distinct wings.

Esther, i. 5.

triumphs. 'This word denoted processional pageants and other festal shows.' Such shows were favourite amusements among the rich men of the time.

returns, sides.

at the first, beginning near the tower.

parlour (Fr. *parloir; parler*, to speak), originally a room for conversation.

or goodly leads, etc., a fine, flat roof, surrounded with statues.

statuas, an Italian word for statues, often used by Shakespeare.

newel, a 'newel is the upright central post of a circular staircase, around which the steps wind in ascending. But when the steps are fastened only with the outer wall, so that there is no central post, but only an open space, as in a well-staircase, it is said to have an open newel' (Lewis).

cast into a brass colour, of a brass colour.

point, appoint.

tunnel, chimney, funnel; so Spenser:—

> 'And one great chimney, whose long tunnel thence
> The smoak forth threw.'

striketh up, reflects.

with a cross. The side alleys or walks are to be paved, and so are the walks that cross them; but the quarters not paved are to lie in grass, which is to be kept short, but not too short.

row of return, the line of buildings on the side that joins the banquet side.

fine, finely.

several works, with various devices.

presence and ordinary entertainments, chambers where the host is *present* to receive and entertain his guests.

double house, with two sets of chambers, one on each side of the central passage.

through lights, windows in a room opposite one another.

from the sun, shaded.

cast it, manage it.

become, go to. Cp. Spenser, 'The dear Charissa, where is she become?'

embowed windows, bay-windows.

upright, level with the wall.

pretty, charming, convenient.

decent, becoming, pure.

it, viz., the under story.

estivation, for summer retreat or enjoyment.

anti-camera and recamera (L. *camera*, a chamber), antechamber and rear-chamber.

to take the prospect and freshness of the garden, to command the view, and so enjoy the enlivening sight of the garden.

by way of return, 'in the second story.'

cabinets, little private rooms.

dantily, prettily.

hanged, the weak form of the past participle of hang. We now use the strong form hung.

avoidances, provision for allowing the waste water to escape.

naked wall, dead, bare wall.

offices, outhouses, stalls, etc. Bacon's idea of a house is a very sumptuous one, and the same may be said of his plan of a garden in the next essay.

ESSAY XLVI.—OF GARDENS.

SUBSTANCE.

GARDENING is the highest of all pleasures. In a perfect garden we should have each month of the year represented. The plan of a princely garden of thirty acres described in detail.

gross handyworks, coarse pieces of human artifice.

shall ever see, note again use of shall for will.

ages, times, epochs.

civility, civilization.

the royal ordering of gardens, if we imagine things to be done in the best way, regardless of cost.

severally, separately.

pine-apple trees, pine-trees.

germander, the speedwell.

stoved, reared in a hot-house.

warm set, planted in sheltered and warm localities.

mezereon, a shrub like a laurel. Its flowers have a very pleasant smell.

crocus vernus, because it comes in spring, vernal.

chamairis fritellaria; some commentators take these words together, and suppose the flower to be the common fritillary, or snake's head, a sort of dark-spotted tulip, which is found in moist places. 'It is now known,' says Lewis, 'as fritillaria meleagris,' but Bacon probably applys the epithet chamairis to it (Gr. *chamai*), because the stalk springs direct from the ground.

cornelian, the dogwood.

flower de luces, a kind of iris.

Damascene, the damson plum, called from Damascus, whence it was brought to Europe.

ribes, currants.

herba muscaria, the fly-trap.

lilium convallium, lily of the valley.

gennitings, early apples.

quodlins, codlins.

apricocks, apricots.

filberds, filberts.

melocotones, a species of quince.
wardens, a good keeping pear (Fr. *poire de garde*, the stored pear).
services, a sort of wild apple.
bullaces, wild plums.
holly oaks, hollyhocks.
Ver perpetuum, perpetual spring.
ast flowers of their smell, their scent is not felt at any distance.
Bartholomewtide, tide is the same as time. Aug. 24th is St. Bartholomew's day.
dying with, which yield when dying.
bent, a kind of grass.
cordial, cheering, comforting. Cf. Milton's 'Comus.'

'And first behold the cordial julep here.'

not passed by, not when they are passed by; observe the condensed form.
prince-like, princely.
contents, extent.
well, much.
going forth, exit on the rear.
either side, each side.
upon, towards.
to buy the shade, as if you were obliged to pay the penalty of exposure to the sun, before you could enjoy the shade.
of either side, on both sides of.
knots, complicated and quaint figures in which the garden beds are laid out.
belly enough, capacity enough.
slope, sloping.
understand, purpose or mean.
deliver you, lead or conduct you.
letting, hindering. So Rom. i. 13. 'Oftentimes I purposed to come unto you, but was let hitherto.'
variety of device, individual tastes.
cast it into, throw or put it into.
busy, complicated, elaborate.
welts, borders or edges.
closer, narrower.
embossments, something which stands out from the rest.
natures, kinds.
fair, clean, proper.
receipt of, reservoir for.
as, that.
doth well, the verb is singular, though it has two subjects. It agrees with its nearest subject *pavement*.
curiosity, elegance.
fine rails of low statuas; there are to be many statues about it.
equality of bores, the means for allowing the water to run off are to be in proportion to those for letting it run on.
arching water, making it take the form of an arch.
but nothing to, conduce not at all to.
prosper, flourish.
withal, at the same time.
sightly, pleasant to look on.
pricked, set, planted,
kept with cutting, regularly clipped.
out of course, out of proportion.
private, secluded.
going wet, to prevent walking in the wet.
ranges, rows.
would be, should be.
deceive the trees, deprive the trees of their nourishment.
pretty height, tolerable height.
make account, note, remember.
aviaries, places for birds (L. *avis* a bird).
as, that.

(To be continued.)

—o—

The New Class-Subject, 'Elementary Science.'

(What to teach, and how to teach it.)

BY RICHARD BALCHIN.

IN this article I propose giving the bare outlines of the easy conversational lessons in this subject, for Standard II. In last month's PRACTICAL TEACHER will be found a reproduction of the first lesson in the course, viz., that on 'the meaning and use of classification.' Following this we have:—

PART I.

(*b*) 'THE THREE KINGDOMS OF NATURE.'

Objects exhibited: Picture of country scene, with trees, cattle, hills, etc.

Subject-matter.—Carry on the idea of classification as worked out in the last lesson. Classify things seen in the picture. Living things: animals and vegetables. Non-living things: stones, hills, clouds, etc. Animals and vegetables feed. Animals can go in *search* of food; vegetables must have it *on the spot*. Animals live and know it; vegetables have an unconscious life. (Note.—This distinction is the only possible one with very young children.) So lead to the primary division of natural objects into animals, vegetables, and minerals.

(Note.—To-day I noticed one of my assistants giving this lesson; he had brought a little boy out before the class, and was dividing the various articles of his dress in this manner; *i.e.*, woollen coat—animal; cotton shirt—vegetable; brass buttons—mineral; etc. The idea was a good one.)

PART I.

(*c*) 'SOME OF THE LEADING MEMBERS OF THE ANIMAL KINGDOM.

Objects exhibited: Pictures of man, ape, lion, elephant, whale, eagle, crocodile, frog, salmon, oyster, worm. Have out the school aquarium, if any. *Ape:* General structure like man; lives in forests, eats nuts, roots. *Lion:* Lives in dens, caves, hides in the tall grass or underwood, flesh eater, notice teeth. *Elephant:* Thick skin, *i.e.*, not torn by shrubs, trees, etc., when searching for its vegetable food. Show a tooth of elephant with its large flat surface with ridges. *Whale:* Not a fish, breathes in the air, suckles its young, a fish does not. *Eagle:* Flesh-eating bird; note beak. *Crocodile:* A reptile, blood cold, lays eggs on banks of rivers, etc. *Frog:* At first a fish (tadpole), breathes the air in the water, then a reptile like a crocodile. *Salmon:* A fish, *i.e.*, lives in water always; breathes the air in the water, and lays eggs. All these animals have back-bones. *Oyster* and *worm* have no back-bones. Therefore animals are classified as (1) back-boned animals; (2) back-boneless animals. (Note.—This lesson may be extended into four or five lessons.)

PART I.

(*d*) 'USEFUL ANIMALS.'

Objects exhibited: Pictures of sheep, cow, ox, silk-worm, horse, mule, ass, and canary. Carry on the principle of classification here, *i.e.*, animals are of use in four ways, viz: (1) They furnish us with food—sheep, cow, pig, fowl, bee. (2) They furnish materials for clothing—silk, leather, wool. (3) They work for us—horse, mule, ass. (4) They give us pleasure, (*a*) by their sweet song—the lark; (*b*) by their beautiful appearance—the canary, etc. (Note.—It is good to keep a bird or two in the school-room: always plenty of volunteers to bring it food and clean its cage.)

PART I.

(*e*) 'VEGETABLES: TREES.'

Objects exhibited: Pictures of lime, plane, sycamore, chestnut, oak, beech, fir. Carry on conversation about the trees found near the school; in some cases *in* the school play-ground; probably the lime, plane, and sycamore. Send a boy for a few *leaves*, etc., of those. Note peculiar flower of lime-tree: point out the *likeness* between the *leaves* of the plane and sycamore, but the *difference* in the shape of the *fruits: i.e.*, the fruit of the plane, two or three balls on drooping stalks; that of the sycamore, in pairs with wings; and if thrown up into the air they spin round and look like a bird; *do* this. Chestnut, oak, beech, fir, good timber trees. School desks, etc., wood of the fir, 'pine.' Notice from the pictures the difference in *shape* between all these trees. Ask if any boy has a tree in his garden; what tree it is,—how he can tell. (Note.—I went last week into the play-ground of a school that had trees planted all around it; but not a boy I asked could tell me the name of any.)

PART I.

(*f*) 'FOOD: VEGETABLES.'

Objects exhibited: Pictures, or specimens of wheat, oats, barley, turnips, carrots, cabbages, fruit, mangel-wurzel, swede, clover, grass.

Classify these as (1) Food for man. (2) Food for other animals. Note the difference in *shape* between wheat, oats, and barley; and between *bearded* wheat and barley; state their uses. Distinguish between the appearance of a field of turnips, carrots, and mangel. (Note.—I was once walking through a field of *mangel* with a lady who had passed the examination for 'advanced agriculture,' and asked her what was in this field? Answer, 'Carrots!') Grass and clover eaten green or dry. Mangel forms good winter food for cattle, when green grass is scarce. Notice how the mangel and swede are stored in the field for winter or spring use.

PART I.

(*g*) 'MINERALS: ROCKS.'

Objects exhibited: Pictures of a stone quarry, a coal mine, an iron mine, and specimens of various kinds of stones and metals, ores, etc.

Classify minerals as (1) rocks, (2) metals. Hold up a piece of sandstone and a piece of iron, note the differences; iron can be hammered out; stone flies to pieces. Stone has rough surface; iron shines. Describe the stones the boys passed on their way to school: sandstones (pavement), granite (kerb), lime-stone (of the houses); show specimens, and point out distinguishing characters. Carry on conversation about the picture of the quarry and the coal mine.

PART I.

(*h*) 'MINERALS: METALS.'

Objects exhibited: Specimens of metallic ores, and picture of a blast furnace.

Ore, the pure metal in union with earthy substance. Work to be done to separate those. Illustrate by describing the process in the case of iron. (1) Roasting the ore in heaps; (2) Melting in blast-furnace along with lime and coal. Production of pig-iron. (Note.—For details of these processes, see 'Hughes' Science Readers,' Nos. 1 and 2; as also for methods of explanation.)

Alloys:—brass = copper and zinc. Bronze = copper and tin (same with bell-metal and gun metal). Pewter = lead and tin. German silver = copper, zinc, and nickel (*i.e.*, contains no silver whatever).

PART II.—'OPERATIONS OF NATURE.'

(*a*) 'THE WORK OF THE SUN.'

Objects exhibited: A landscape in summer, with a few clouds, and the sun shining. Carry on a conversation about the picture, *i.e.*, looks warm; heat derived from the sun.

(1) Sun's heat causes rain; explain how water-vapour is raised in the air, becomes clouds.

(2) Sun's heat causes wind; explain how heat rarefies air and causes it to ascend: if possible let up a 'fire-balloon.' (Note.—At the close of a lesson on this subject, one of my assistants took his division into the play-ground, made them form in a circle around him, and then sent up a tissue-paper balloon; in the opening at the bottom, he had placed a piece of wire, on which was fixed a small sponze soaked in methylated spirit.)

(3) Sun's heat produces ocean currents. Explain how this is done. Can be illustrated by a very pretty experiment. Fill a large glass vessel—a fish-globe answers capitally—with water; throw in a handful of fine saw-dust; place a small piece of hot iron in a little floating iron saucer; notice, by the movements of the particles of saw-dust, how this heat sets up currents.

(4) Sun's heat ripens vegetation and fruits. (Note.—The teacher will probably find it necessary to make *four* lessons on this subject—the work of the sun.)

PART II.

(*b*) 'THE WORK OF WATER.'

(1) The work of rain.

Objects exhibited: Picture or model of a river basin; or, of a summer scene during a shower of rain.

(*a*) Rain in falling clears the atmosphere of (1) bad air; (2) of substances good for plants, but bad for animals.

(*b*) Rain wears away land, deposits the *wear* in valleys, or by rivers carries it to the sea to form banks, etc.

(*c*) Work of springs. Explain formation of a spring. Springs form caverns in the earth; *i.e.*, they wear away solid parts of the earth's interior; bring the *wear* to the surface; *i.e.*, lime-springs of Yorkshire, flint-springs, iron-springs, the brine-springs of Cheshire, etc.

(*d*) Work of mountain streams, rivers, etc., turning water-wheels; bringing good soil to the valleys.

(*e*) The work of the ocean. Sea never still; continual motion results in work. Wears away coasts; if material is soft like the cliffs of North Kent, then the wear is rapid,—notice the old roads which ran from Herne Bay to the Reculvers. If material of the coast is hard, the wear is slow and the coast rugged and rocky—notice the coast of Cornwall. Straits of Dover, etc., a passage cut by the sea through chalk. Ocean currents form banks by shifting material from one place to another.

(*f*) The work of ice.

(This subject, 'the work of water' will form material for at least six good thought-awakening lessons.)

As the last operation to be noticed under this head may seem, to many teachers, to be far too advanced for second-standard children, I will in next month's article reproduce the lesson as actually given. I allude to that upon 'the work of ice.'

(To be continued.)

Science Notes.

A NOVEL FLYING MACHINE.—An interesting exhibition of a newly-invented flying machine was conducted between Colnbrook and West Drayton during the past month. Mr. H. C. Linfield, of Upper Grove, Margate, has constructed the apparatus, which consists of a frame of light wood, with two large wheels in front and two small ones behind. The machine is to be propelled by steam, working a nine-bladed screw, on land until sufficient velocity—say from thirty to thirty-five miles—is obtained to lift the machine in the air, when it will be navigated by affixed sails. Mr. Linfield hopes to find it possible to travel through air at as great a distance as a mile from the earth. The trial experiment was made on the newly-finished portion of the railway to Staines, and completely satisfied the inventor. The machine was placed on one truck, the gearing was managed from another, and the steam obtained from an engine connected with the former. The machine was fairly lifted from the truck into the air, and it was decided that this was sufficiently satisfactory for the first trial. Should Mr. Linfield persevere, it may be doubted whether he will—as he hopes—effect a great revolution in air navigation, or merely add a few more names to the already dismally long list of fatal aeronautic accidents.

* * * * *

TWO COMETS are said to be about to revisit us; the first, that of 1812, according to Encke's calculations should already be here, but slight errors have been detected which would point to its period being slightly longer. However, it will probably be seen within the next few months. The other is the periodical comet discovered by Tempel on July 3rd, 1873, and which passed its perihelion on the next return August 27th, 1878, and which is therefore due again towards the end of October.

* * * * *

CONTAGION IN STONEWARE.—A very curious discovery was announced in a paper by M. de Peyrusson before the Académie des Sciences, August 13th. The learned investigator proved that germs of such virulent epidemics as cholera, typhus, etc., may settle and be preserved in the slightest cracks in the glazed surface of any stoneware. This is an additional proof of the need of strict and efficient superintendence of treatment and nursing in these terrible diseases, which it seems so difficult to successfully combat.

* * * * *

COPPER AND CHOLERA.—Our readers will probably have noticed during the ravages of cholera in Egypt a suggestion made to the French Academy of using copper as a specific against that disease. An interesting confirmation of the theory appears in *Nature*, of last month: it is said that at the large and well-known copper mines of Fahlun, in Sweden, cholera has never been known, and that when cholera last visited Sweden several members of the royal family took up their residence at Fahlun, and escaped the disease. Not a particle of vegetation is to be found for miles around the mines, while the air is loaded with fumes of copper. It would therefore seem that another and a more effectual remedy, or rather preventive, has now been discovered for this worst of pestilences.

* * * * *

NATURAL SCIENCE IN SCHOOLS.—Those teachers who find it difficult to fix the attention and command the progress of their scholars in natural science will do well to lay to heart the excellent hints contained in a Swiss address on the subject which is published by the United States Education Bureau: it insists upon the fact—too little recognised in every branch of study—that a knowledge of facts is not everything, nor even a great deal. The scholar should be taught to discover his facts for himself or with the teacher's aid, not merely from text-books; everything should be seen and then described, so as to fix it indelibly on the mind. Plants because plentiful are best to begin upon, then animals may be taken, and later still minerals. Two other lessons are impressed on the teacher, first, that 'cram,' everywhere fatal, should be most guarded against here, because so easy for both teacher and taught; secondly, that the most backward as well as the quickest of the scholars must be fully informed on every particular. This may seem a high ideal of teaching, but till it is taken to heart our scholars will be superficially informed, and the less intelligent will be hopelessly confused by a mass of names unassociated with anything they have seen.

* * * * *

BRONTOSAURUS.—This remarkable animal has been reconstructed from bones belonging almost wholly to one specimen, by Professor O. C. Marsh, of America. The animal was about fifty feet long, with a long, flexible neck, very short body, tremendous legs and feet (the latter leaving footprints a square yard in area), a very large tail with solid bones. Its head was smaller in proportion to its body than that of any other known vertebrate, the skull being less in diameter and

weight than the fourth or fifth cervical vertebra. After this it is a relief to read that the animal was harmless, without any offensive weapons, slow in motion, and feeding on succulent plants—but it weighed over twenty tons!

* * * * *

A PENNY WATER-PURIFIER.—A novel water-filter is suggested by Mr. Frederick Guthrie, of South Kensington Science Schools. His directions are as follows:—Take a flowerpot and break out the bottom so as to allow half a brick to stand in it, with one corner projecting through the bottom; break up the other half of the brick into small pieces and put them in the pot. Soak the whole in water for a night, and let it drain. Then allow water to drip on the pieces of brick, and after awhile pure and wholesome water will run out from the bottom. Mr. Guthrie explains the method as depending on aëration, and the fact that no disease germs in water can escape the purifying influence of oxygen, while the desiderata are to allow the water to run over the largest surface possible, and free exposure to the air during the filtration.

* * * * *

STORM SOUNDS IN A TELEPHONE.—A somewhat important investigation was carried on under remarkable conditions by a correspondent, E. B., of *L'Ingénieur Conseil*, at Brussels, on 30th June. On that day a severe thunderstorm visited the city, and E. B. amused himself by listening to the storm sounds in the telephonic wire: he says that when the storm was at its height there was a continuous noise like that of something frying. Sometimes a louder noise as of a bubble bursting might be heard, and sometimes the crackling noises made by drops of grease falling on a red-hot plate. It is very curious that the observer seems quite confident that he heard this last noise, and that, too, louder than at other times with each flash of lightning and preceding it; the same noise was often heard, but less plainly, without any accompanying flash. The observation seems to have been quite unattended with danger, for on the 600 lines of telephone-wire focussing at Brussels, not one apparatus was damaged, the lightning-rods and storm-warning apparatus proving quite sufficient to divert the energy of the storm. E. B. thinks that by similar investigations valuable additions may be made to the study of atmospheric electricity: he is further of opinion that the noises heard in the wires prove the existence of a current of atmospheric electricity in them flowing towards the earth, and that thus a network of telephonic wires over a town would be the most effective protection against lightning.

* * * * *

METEORS IN SCANDINAVIA.—A magnificent meteor was noticed in Sweden on the 6th August last, near Lake Vettern: its direction was from W. to E., and it was visible for exactly two minutes as it passed comparatively slowly across the sky. Its head was very fine and lustrous, and its tail somewhat resembled a comet, while it left behind a shining track which lasted for several seconds. Another meteor was seen at Sarpsburg, in Norway, just a week later, and at the same hour, about 9 p.m. This one was like a fireball with a long bright tail, and passed across in an easterly direction, being in view for about one minute.

A PURE CARBON FOR ELECTRIC PURPOSES.—M. Jacquelain has succeeded in preparing a pure carbon for electric purposes which is as hard and as conductive as gas carbon. Gas carbon is purified by four successive processes: first, it is heated with dry chlorine at a red heat for thirty hours; secondly, with hot alkali for about three hours; thirdly, it is immersed in hydrofluoric acid, diluted in the proportion of one to two of water, at a temperature of from 15° to 25°; fourthly, it is carbonised by heating strongly in the vapour of a high-boiling hydrocarbon—gas tar being recommended for commercial purposes. The carbon is then cut into sticks, and the impurities will have thus been reduced to a minimum.

* * * * *

EFFECT OF LIGHTNING ON TREES.—Professor Colladon, of Geneva, has recently been prosecuting his investigations as to the effect of lightning on trees: his observations have led to the following interesting results. He finds that lightning chiefly injures the lower portion of the trunk, leaving almost untouched the upper portion and branches, a fact which he ascribes to the greater impregnation of the latter with sugar—a good conductor. During the many instances which have come under his notice of late by reason of the frequent thunderstorms in Switzerland, he has found many trees with the upper portions uninjured, while the lower trunk has been shattered. Oaks would seem to form a very remarkable exception, as the professor has noticed many of them with their tops blasted by the electric fluid, while its passage down the trunk is marked by a deep furrow. This furrow sometimes winds round the trunk, following, says the Professor, the cells of which the bark is composed lengthwise, and these cells being disposed spirally. Another curious action of lightning, on vines, is also noticed: it invariably strikes a number of vines together included in a circle of from eight to twenty-five mètres in diameter, most affecting those in the centre, and gradually diminishing its injurious effects towards the circumference.

ANSWERS TO ALGEBRA QUESTIONS IN 'THE SCHOLAR,' FOR OCTOBER, 1883.

EXERCISE XXVI.

(1) $\frac{9+4x}{15}, \frac{5ab}{30-4x}$

(2) $\frac{3x+24y}{18x+5y}; \frac{1}{2x-1}$

(3) $\frac{3x^2y}{4x^3+y^3}, \frac{4(x+5)}{3(x-5)}$

(4) $\frac{1-x}{(1+x)^3}; \frac{4}{a+x}$

(5) $\frac{(x+2y)(x-y)}{2y^3}; \frac{1}{y}$

(6) $\frac{x(1+2x)}{1+3x+x^3}; \frac{4}{3x}$

EXERCISE XXVII.

(1) 24

(2) $27\frac{7}{8}$

(3) 26

(4) $253\frac{1}{16}$

(5) 122

(6) $1\frac{8}{16}\frac{8}{16}$

(7) $\frac{a(ac+b^2)}{a^2+bc}$

(8) $\frac{abc}{b+c}$

(9) $-\frac{1}{3}$

(10) 1

(11) $2\frac{3}{11}\frac{3}{11}$

(12) $\frac{1}{2}(5a+3b)$

(13) $2\frac{1}{2}$

(14) $6\frac{1}{3}\frac{7}{3}$

(15) $-\frac{3}{8}$

(16) $\frac{a^2-b^2}{4a+b}$

(17) 6

(18) 2

(19) 3·3

(20) $\frac{8}{8}$

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ANSWERS TO ARITHMETICAL QUESTIONS IN THE 'SCHOLAR' FOR OCTOBER, 1883.

STANDARD IV.

A. 1. 29,462,400 sec.
2. 214 tons 8 cwt. 5 lb. 7 oz.
3. 854, and 7s. 3½d. left.

B. 1. £30,276 4s. 6¾d.
2. £90s. 10½d.,—8416.
3. 1,411,344 sq. in.

C. 1. 22 st. 11 lb. 5 oz. 5 dr.
2. £45 3s. 4½d.
3. £22,079 17s.

D. 1. £1 1s. 3d. gain.
2. 1 c. yd. 26 ft. 180 in.
3. £111 9s. 6d.

E. 1. 73 wk. 4 d. 3 hr. 59 m.
2. 18,300 nuts.
3. 454, and 1 lb. left.

F. 1. 9 m. 1322 yd. 11 in.
2. £57,482 5s. 6d.
3. 4836 strokes.

Advanced Examination.

1. 113 vests, and 3 nl. left.
2. £44 9s. 10½d.
3. 156 ton.

STANDARD V.

A. 1. £2895 8s. 4½d.
2. £4 0s. 2d.
3. £36 16s. 3$\frac{9}{10}$d.

B. 1. 3$\frac{3}{4}$.
2. $\frac{19}{120}$.
3. £8 13s. 3½d

C. 1. £1103 6s. 8d.
2. £34 12s. 10$\frac{5}{9}$d.
3. 1194½ ton.

D. 1. £11 0s. 8$\frac{1}{2}$d.
2. 4$\frac{33}{56}$.
3. £696 19s. 4$\frac{8}{11}$d.

E. 1. 103 ton 4 cwt. 2 qr. 22 lb.
2. £338,369 0s. 9d.
3. £1,689,770 min.

F. 1. £124 3s. 5$\frac{1}{2}$d.
2. £51,021 5s.
3. £237 5s. 3$\frac{1}{2}$d.

Advanced Examination.

1. £3 11s. 6d.
2. £29 12s. 9$\frac{3}{11}$d.
3. £3985 1s. 11$\frac{1}{2}$d.

STANDARD VI.

A. 1. 1$\frac{3}{8}$.
2. £1 18s. 2$\frac{7}{16}$d.
3. 41 ton 13 cwt. 25$\frac{1}{2}$$\frac{3}{4}$ lb.

B. 1. £78 6s. 4$\frac{3}{12}$d.
2. 980 books.
3. $\frac{1}{2}$$\frac{1}{3}$.

C. 1. £62 10s. 7$\frac{1}{2}$$\frac{7}{8}$d.
2. 4$\frac{1}{12}$ per cent.
3. 4000 ton.

D. 1. 21$\frac{8}{9}$$\frac{32}{33}$$\frac{11}{12}$.
2. £3 14s. 4$\frac{5}{7}$d.
3. $\frac{2}{3}$$\frac{1}{1}$$\frac{2}{3}$.

E. 1. 19$\frac{1}{2}$ hours.
2. 152$\frac{1}{12}$ days.
3. £2159 1s. 3d.

F. 1. ·0025468+
2. $\frac{1}{5}$$\frac{2}{2}$$\frac{1}{5}$.
3. £40 10s. 2·592d.

Advanced Examination.

1. 18$\frac{1}{2}$$\frac{5}{6}$ hours.
2. 76$\frac{4}{11}$ pears.
3. 7s. 8$\frac{2}{7}$$\frac{1}{1}$d.

STANDARD VII.

A. 1. £74,934.
2. £113 11s. 7·8975d.
3. £17 4s. 2$\frac{3}{4}$$\frac{1}{4}$d.

B. 1. £1 10s. 11$\frac{1}{2}$$\frac{3}{4}$$\frac{3}{8}$d.
2. £28 8s. 66$\frac{8}{1}$$\frac{0}{9}$$\frac{0}{7}$d.
3. £32 5s.

C. 1. £1555.
2. 5s. 7½d.
3. 2s. 2$\frac{1}{1}$$\frac{3}{4}$$\frac{4}{1}$d.

D. 1. 16$\frac{3}{7}$ per cent. loss.
2. 208 a.m., 195 p.m.
3. 11¼ per cent.

E. 1. $\frac{5}{6}$$\frac{4}{4}$, or ·078125 p. ct.
2. 66⅔ per cent.
3. £41 12s. 7·7571072d.

F. 1. £8800.
2. £7222 4s. 5½d.
3. £27,551 11s. 3d.

Advanced Examination.

1. 16¼ per cent. gain.
2. £650.
3. £25 15s. 6¾d. inc.

SOLUTIONS OF THE 'ADVANCED EXAMINATION' QUESTIONS IN THE 'SCHOLAR' FOR OCTOBER, 1883.

STANDARD IV.

1. 3 yd. 1 qr. 2 nl. × 9 = 30 yd. 1 qr. 2 nl. required for the coats, which from 80 yd. = 49 yd. 2 qr. 2 nl. = 794 nails. Then as 1 qr. 3 nl. = 7 nl., 794 ÷ 7 = 113 vests, and 3 nl. left. Ans.

2. 960 ÷ 6 = 160 lb. on each tree, and 160 × 63 = 10,080 lb. = 4½ ton, which at £9 17s. 9d. a ton = £44 9s. 10½d. Ans.

3. ¾d. × 120 = 90d. = 7s. 6d. = 3 halfcrowns cost of one ton. £58 10s. = 468 h.-crowns, which divided by 3 = 156 ton. Ans.

STANDARD V.

1. 3½ c. ft. × 12 × 2½ × 220 = 21,450 = 214½ hundred c. ft. Again, 3s. 4d. a 1000 = 4d. a 100, and 4d. × 214½ = 858d. = £3 11s. 6d. Ans.

		£	s.	d.				
2.	9 ft. is $\frac{1}{3}$	1	18	3				
				15				
		28	13	9	price of 15 yd.			
	3 „ „ $\frac{1}{3}$		12	9	„	„	9 ft.	
	1 „ „ $\frac{1}{3}$		4	3	„	„	3 „	
	576 in. „ $\frac{1}{3}$		1	5	„	„	1 „	
	192 „ „ $\frac{1}{3}$			$5\frac{1}{3}$	„	„		576 in.
	24 „ „ $\frac{1}{3}$			$1\frac{2}{3}$	„	„		192 „
				$0\frac{17}{18}$	„	„		24 „
	Ans.	£29	12	$9\frac{13}{18}$	„	15	13 „	792 „

3.	£	s.	d.
$3\frac{1}{2}$ acres = 16,940 sq. yd., at 5s. 6d. =	4658	10	0
19,965 sq. yd. = $4\frac{1}{2}$ acres, at £72 10s. =	299	1	3
$4\frac{1}{2}$ sq. chains at £155 an ac. = £15·5 a chain =	69	15	0
$8\frac{1}{2}$ sq. yd. at $2\frac{1}{2}$d. a sq. in. = £13 10s. a yd. =	114	15	0
	5142	1	3
Less 4s. 6d. in the £ =	1156	19	$3\frac{3}{4}$
Ans.	3985	1	$11\frac{3}{4}$

STANDARD VI.

1. $\left(\frac{8\frac{3}{4}}{24}+\frac{8\frac{3}{4}}{20}\right) = \left(\frac{35}{96}+\frac{35}{80}\right) = \frac{77}{96}$ part done by A and B. $1-\frac{77}{96}=\frac{19}{96}$ frac. done by C in $3\frac{3}{4}$ hours. $\left(\frac{19}{96}\div 3\frac{3}{4}\right)=\left(\frac{19}{96}\times\frac{4}{15}\right)$ $=\frac{19}{360}$ frac. done by C in *one* hour; hence $360\div 19=$ $18\frac{18}{19}$ hours. Ans.

2. There would be 400 *nuts* for the shilling, and $\frac{3}{4}$ as many cherries as nuts, $\frac{3}{5}=\frac{3}{5}$ as many plums as cherries, etc. Hence $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ of $400=76\frac{4}{21}$ pears. Ans.

3. By compound proportion and cancelling,

$$\frac{£25\times 60\times 75}{8\times 100\times 365}=£\frac{225}{584}=\text{7s. } 8\tfrac{13}{73}\text{d. Ans.}$$

STANDARD VII.

1. We will suppose the goods cost a specific amount, say £1600, as it is easily divisible by the fractions given.
Then £800 × 1·35 = £1080 selling price of $\frac{1}{2}$ the goods.
£500 × 1·2 = £600 „ „ $\frac{5}{16}$ „
£300 × ·6 = £180 „ (rem.) $\frac{3}{16}$ „
£1860 „ „ the whole.

£1860 − £1600 = £260 gain on £1600, and £260 ÷ 16 = $16\frac{1}{4}$ per cent. gain. Ans.

2. £1 at comp. int. would amount to £1·21550625 in the 4 years; then £790 1s. $6\frac{2}{40}$d. or £790·0790625 ÷ £1·21550625 = £650. Ans.

3. 40 (hundreds) × 3 = £120 income from consols. £102·5 (broker receiving the other $\frac{1}{4}$) × 40 = £4100 sold out for. £112$\frac{3}{8}$ + $\frac{1}{4}$ brokerage = $112\frac{1}{2}$ cost of each £100 debenture. £4100 ÷ $112\frac{1}{2}=36\frac{4}{9}$ no. of £100 debentures bought. £$36\frac{4}{9}\times 4=$£$145\frac{7}{9}$ income from the debentures. £$145\frac{7}{9}$ − £120 = £$25\frac{7}{9}$ = £25 15s. 6$\frac{3}{4}$d. increase. Ans.

ANSWERS TO ARITHMETICAL QUESTIONS IN THE 'LITTLE LEARNER' FOR OCTOBER, 1883.

STANDARD I.

A. (1) 173
(2) 167
(3) 248
B. (1) 783
(2) 885
(3) 1,706
C. (1) 988
(2) 2,722
(3) 1,469
D. (1) 432
(2) 531
(3) 238
E. (1) 314
(2) 24
(3) 96
F. (1) 187
(2) 94
(3) 689
G. (1) 7,863
(2) 8,525
(3) 24,587
H. (1) 3,848
(2) 1,767
(3) 57
I. (1) 21,241,227
(2) 143 eggs
(3) 40 miles
J. (1) 2,025,303,540
(2) 30 years
(3) 131 pounds

STANDARD II.

A. (1) 97,538
(2) 95,843
(3) 338,726
B. (1) 16,606
(2) 16,588
(3) 35,996
C. (1) 296,136
(2) 5,666,320
(3) 19,323,500
D. (1) 2,190,636
(2) 2,162,132
(3) 27,465,320
E. (1) 117,515,964
(2) 356,086,830
(3) 7,599,701,300
F. (1) 34,709
(2) 17,708+3
(3) 7,039
G. (1) 7,800+4
(2) 2,638
(3) 7,991
H. (1) 7,721+47
(2) 993+420
(3) 3,750+106
I. (1) 44,540
(2) 30,720 farthings
(3) 11 years
J. (1) 16s. 4d.; 116 pence
(2) 150,185
(3) 70 marbles

STANDARD III

A. (1) 2,345
(2) 1,089+14
(3) 879
B. (1) 14,018+16
(2) 7,018+7
(3) 3,609
C. (1) 7,027+74
(2) 4,970
(3) 11,024+359
D. (1) 16,011+4,402
(2) 6,807
(3) 11,578+7,760
E. (1) £27 19s. 9d.
(2) £106 1s. 10d.
(3) £1,637 12s. 0$\frac{1}{2}$d.
F. (1) £7,429 7s. 9$\frac{1}{2}$d.
(2) £18,151 12s. 9$\frac{3}{4}$d.
(3) £69,529 15s. 5$\frac{1}{4}$d.
G. (1) £108 18s. 4d.
(2) £556 5s. 8$\frac{1}{2}$d.
(3) £28 14s. 9$\frac{1}{4}$d.
H. (1) £3,559 10s. 9$\frac{1}{2}$d.
(2) £698 16s. 8$\frac{3}{4}$d.
(3) £50,488 11s. 8$\frac{1}{4}$d.
I. (1) 64 days
(2) £2 6s. 9d.
(3) £259 10s. 7d.
J. (1) 37,840 times
(2) Sheep £3 3s., goat £1 1s., pig £1 16s.
(3) 28 books

Publications Reviewed.

Domestic Economy. New Edition, in 3 Parts. London: W. and R. Chambers.

These three little books are a fairly good compilation of facts and ideas about the various subjects understood to be included in Domestic Economy. The work contains, however, no real science, that is to say, no reasoning about the matters on which it treats; and it is improbable, therefore, that the study of it will be of much use to girls. In more than one instance there are really errors of fact, dependent upon the absence of reasons; for the error in the fact as stated would at once become apparent if reasons for it were sought. But apart from this, we could wish to see our girls taught to reflect upon the causes of the every-day precepts which are here set forth, and not merely called upon to receive them from the teacher *ex cathedrâ*. For instance, we have here in the section on cooking a series of remarks on stewing, to which no exception can be taken as practical teaching, but which are of little real value, because the reasons upon which they are based are left out; and it is simply because working women do not understand reasons that they blunder in domestic matters as they do, until long practice gives them the rule-of-thumb wisdom which can only be acquired by experience, though it may be learned from scientific teaching. 'All coarse or dry pieces of meat should be stewed, as by that means they can be made as nice and digestible as the better parts. The secret of good stewing is long, *slow* cooking, in a vessel with a close-fitting lid.' So far, good; but to have read this, or even to have learned it by rote, will never prevent a girl from popping a piece of leg of beef in a saucepan of water hot from the boiler, with a pinch of salt, and putting it to boil hard over a good fire, and offering the watery decoction for beef-tea. Ten minutes spent in scientific explanations of reasons, however, in showing that in meat there is a substance analogous to the white of an egg, and that when once this is hardened by boiling heat, the fibres cannot be dissolved, and in teaching *why* hard boiling cooks no faster than simmering, and not so completely, this would give a fresh

turn to the learner's mind, which would never lose its effect upon her practice. These little books, like all Messrs. Chambers' publications, are well printed, upon good paper, and strongly stitched.

Chambers's Geographical Readers. Standard V. London and Edinburgh: W. and R. Chambers.

We have pleasure in repeating with respect to this book what we have already said concerning the earlier volumes of the same series. It is an excellent reading-book, well adapted, by the entertaining style in which it is written, by its capital arrangement, and by the profuse and high-class illustrations with which it is adorned, to awaken and sustain the interest of the children who use it. This volume, for Standard V., deals with Europe, and contains a large amount of information respecting the main geographical and political features of the countries of that portion of the world. The last ten chapters are occupied with a careful and well-written description of the various motions of the earth and their effects, the meaning of latitude and longitude, and with the explanation of those many other facts which, though appertaining to the borderland of astronomy and geography, are yet necessary for the complete understanding of the latter.

Elementary Science Reader. By Charles Macrae, M.A. London and Edinburgh: W. and R. Chambers. 1883.

This is intended as a Reader for Standards I.-III. of schools in which elementary science is taken as a class-subject. It is clearly printed in a large type, and the illustrations are as a rule clear and well drawn. The fat cells drawn have an appearance very unlike their natural one, and the white corpuscles depicted show pseudopodia as large as those of any rhizopod—pseudopodia which are only very faintly visible in man. Ordinary white corpuscles seen under a microscope are circular.

The matter of the book is clearly put together and simply expressed. The verbal illustrations are often happy, and with the aid of the stories given would be sure to make the subject popular.

We are sorry to see here and there loose statements, doubtless introduced for simplicity's sake.

Thus, 'the roots dissolve such substances as lime, phosphorus, iron, and sulphur.' Most beginners would derive the impression that the phosphorus is dissolved in the same condition as it exists on the tip of non-safety matches. We do not believe in sacrificing accuracy to simplicity.

Another illustration of the same thing occurs a little later. We are told that hard water contains lime dissolved in it. It would have been just as easy to call it chalk, and much more accurate.

We are glad to see that the study of science is becoming thus popularised, and this book is an honest and careful attempt at giving in a popular manner the main principles of physical and biological science.

The Exodus, Wall-Map to Illustrate. London: A. Johnston.

To those teachers, in week-day and Sunday-schools, who are in want of a really serviceable wall-map explanatory of the journeyings of the Israelites after leaving Egypt, we have pleasure in recommending this production. Clearness and legibility are the great *desiderata* of a wall-map; and in this case nothing has been omitted that can contribute to these good qualities. The tints selected are decided without being glaring and obtrusive, and the printing is all that could be desired. We note that one of the latest additions to Biblical topography—the identification of Tel-el-Maschuta, of Egyptian campaign fame, with the Pithom-Succoth of the Scriptures—has been embodied in the map.

How to Teach the Method of Unity. By Alonzo Gardiner. London; John Heywood.

This book was originally written to supply a want produced by an order from the Education Department, to the effect that questions in proportion were to be worked by the method called that of unity.

This order having since been modified, Inspectors being again permitted to accept the old method, an appendix has been given explaining it.

The author of this book only claims for himself the invention of a somewhat neater method of statement, recommending the gradual formation of the final fraction, by which the answer is to be found. The operation, we are bound to say, seems to become as mechanical as, or more so than, the old method of stating, when the question is worked as a proportion. The book is sadly marred by the unhappy, and in fact improper expressions, '4 times more than' and '4 times less than.' We think it was the great de Morgan who exposed the impropriety of such expressions with all the power of his wondrous pen. To say that '16 is 4 times more than 4' is utter nonsense; 16 is no doubt 4 times 3 more than 4, since 4 times 3 equals 12, and 16 is 12 more than 4, but this is not what the author means. Why the author was afraid to use such expressions as 'four times as much as' or 'one fourth of' we cannot imagine.

Example 107 contains some very extraordinary statements; and it is strange that one writing on the subject of units could fall into such errors. The question referred to is as follows:—Eggs are bought at 7½d. a dozen, and sold at 16 for a shilling; what is the gain per cent.? The author begins by saying that the sum *may* (the italics are ours) be worked out in three ways, of which the last is the right one. This is manifestly impossible, and so, though he seems to know it not, the author has shown. Had he realized the impossibility of equalizing two things of different denominations, he would have seen at once that all his results were precisely the same. He first works out the example something in this way: Having found that 19⅓ eggs cost 1s., he shows that the gain on 1s. is 3⅓ eggs, and from this he deduces quite rightly that the gain on 100 pence is 26⅔ eggs, and calls this 26⅔ per cent. one answer; but, 26⅔ eggs would produce 20 pence, and since the percentage on pence must be pence, we immediately get what is called the right answer. He next proceeds to find the gain on 12 eggs, and this he tries to show is something quite different: viz., 12½ p.c. Here, again, he is trying to equalize quantities of different denominations. Having shown that the gain on selling 100 eggs is 12½ pence, he forgets that the 12½ pence will exactly be received for 20 eggs, so giving the same answer. How an author can so mislead his readers by not explaining the seeming fallacy we cannot understand. If a thing purchased at a certain price is sold so as to gain 20 p.c., it is not possible so to distort the question as to get any other answer. If in the hundred, the unit used is an egg, the answer must be expressed in eggs, before we can state the percentage gained. This example is called a most instructive one;—as at present left in the book, we should call it a very mischievous one, especially as the author, though stating that the 20 per cent. which he finds in his third method of working the question, is the only right answer, implies that some other result *might* be asked for, which would seem to mean that if the question had been asked—'What is the percentage gained on selling twelve eggs?' the right answer would be 12½ per. cent.

In the early part of the book, too, there is another mistake, where the very question of 'unit' is the pit into which the author has fallen. He divides 112 shillings by 5 and obtains as result 22s. 4⅘+⅕d. If the + implies that the ⅕d. is remainder, and no part of the quotient, the result is certainly wrong, and the remainder is ⅕d. and not ⅕d; if, on the other hand, the ⅕d. is part of the quotient, it is as manifestly wrong, as in that case the ¼ is ¼ of a farthing.

We do not wish to be hypercritical, and therefore doubt not for a moment that in Example 108 'apples' is misprinted for 'pence.' Examples 109 and 111 are capital

ones to show how the Unit Method at times breaks down, as one of simplicity and perfect intelligibility, for which of course the author is not responsible. Example 109 is this: In a school of 153 children, 125 pass, what is the percentage? The working is as follows: Passes in 153 children = 125: passes in 1 child, $\frac{125}{153}$, etc. We should like to hear a boy or girl talk about this fraction in an intelligible manner.

Happily this book is not intended for children, but for teachers, who it is hoped will carefully examine every statement and denomination (in other words, unit) found therein, before he uses it for his pupils.

The Examples here worked out are taken from Messrs. Heywood's home-lessons. There are no Examples for practice. The printer and binder have done all they can to make the little book attractive.

Double Entry Book-Keeping. By Daniel Sheriff. Third Edition.

Single Entry Book-Keeping. By same Author. London: W. H. Allen and Co.

In the former of these books the author believes he has given an unfailing rule, by the following of which the student is unable to make a mistake in the operation known as journalising. That there are certain operations —such as passing on, or accepting a bill drawn on another than the firm—when the old test as to what is debtor and what creditor, is difficult of application we cannot deny; but we very much doubt if the majority of students would not far more easily journalise ninety-nine transactions out of every 100 by the old method than by the one given here.

We should feel inclined—in spite of the strong, too strong, language of the preface—to recommend the adoption of both tests as preferable to that of either, to the utter exclusion of the other. Surely it is a useful exercise to get to the same result by more than one method. Those people who, having got hold of an idea with regard to a *science*, try to fit everything into that one idea, distorting facts, almost ignoring logical methods, do far more harm than good. There is nothing scarcely that is not capable of such modification as to become, under certain circumstances, what seems to be an exception; and the sooner such exceptions are acknowledged the better.

The difficult operation of journalising bills, both receivable and payable, is thoroughly well explained, which may also be said of preparing the balance sheets; and we are quite certain that the book would have presented itself to us in a far more favourable light, had it not been for the tone of the preface, which is disagreeably self-asserting.

The Single Entry volume gives a form of 'a proof or trial balance' which promises to remove the defect of Single Entry, viz., the incapability of being periodically tested.

The author says in his preface to this book, 'Let no one suppose that this system is mixed up with Double Entry, as by Double Entry there must be an equal amount of debtors and creditors represented in each transaction, and things are personified and treated as persons; but in Single Entry the accounts of the day book and ledger represent persons alone.' This, no doubt, is perfectly true; but if the mutuality of debtor and creditor be thoroughly understood, together with the fact that the cash book is only an overgrown folio in the ledger, and that the invoice and sales books are respectively the debtor and creditor sides of another folio of the ledger, what, we ask, is the difference of principle between the two systems? However wise it may be to keep the actual booking clerk clear of the system he doesn't work in; as a matter of education, the two might, with great advantage, be taught side by side.

We should have thought that, in addition to the treatment of the transactions referred to in these books, there might have been a chapter devoted to the description, etc., of accidental books that occur in nearly every business, *e.g.*, Wages, Casks, etc., or some of the many used by bankers and insurance offices. We cannot help believing that it is this very omission of clear statements of the principle, upon which such accidental books are kept, that causes the remark to be so often made by merchants, to the effect that no taught system of book-keeping would suit his particular business. We maintain, however, if a little more attention were paid to explaining the principle upon which the whole science is based, that *that* knowledge of book-keeping, which can be got from books and schoolmasters, would be more valued by employers than it is.

*** *Several reviews are crowded out.*

Publications Received.

Burns and Oates—
Poetical Recitations. Nos. 1, 2, 3, 4, and 5—*The Granville Series.*

Chambers (W. and R.)—
Elementary Science Reader.
Advanced Physiography. By A. Findlater, M.A., LL.D.
Elementary Mechanics. By J. Williams.
Burns' The Cotter's Saturday Night and The Twa Dogs.
Scott's Lord of the Isles. Canto VI.

Education Department, Adelaide, S. Australia—
Comparative Tables of Information as to the Education Systems of England, the Australian Colonies, and New Zealand.
Report of the Minister Controlling Education. With Appendices.
Map of Australia and New Zealand.

Griffith and Farran—
The Standard Authors Readers. Nos. 1, 2, 3, and 4.
Our Little Ones. Vol. III. No. 2. September.

Heywood (John)—
Standard Poetry, with Explanatory Notes and Biographical Sketches.

Johnston (W. and A. K.)—
Pictures from the Holy Bible, with Descriptive Text.

Kent and Co.—
Sydow's German Conversation Grammar.

Laurie (Thomas)—
Laurie's Copy-Books. Nos. 1 to 12.
Laurie's Merit Certificates.

Longmans and Co.—
Longman's Magazine. No. XI. September.

Marcus Ward and Co.—
Ivanhoe: A Romance. By Sir W. Scott, Bart. School Edition. Edited by A. Mackay.

Murby (T.)—
Murby's Historical Reader. Book 2.
Murby's Imperial Class Register of Attendance and Fees.

Nelson and Sons (T.)—
The Combined Lesson Books. Standards I., II., III., and IV.
The World at Home. Standard V.

Philip and Son (George)—
Philips' Historical Readers. Nos. 2, 3, 4, and 5.
History of England and Wales, from the Roman to the Norman Conquest. By T. Morgan Owen, M.A.
A Complete Course of Arithmetical Examples and Exercises. By T. W. Piper.
Philips' Standard Poetry Books. Nos. 1, 2, 3, and 4.
Science Ladders. No. 4. Flowerless Plants.
Philips' Excelsior Atlas.

Shepherd and Kilner.—
A Guide to the Pianoforte. By Alfred Walker.

Smith, Elder and Co.—
The Cornhill Magazine. No. 3. September.

The Cambridge University Press—
Theory and Practice of Teaching. By the Rev. E. Thring, M.A.

Ward, Lock and Co.—
Universal Instructor. Part 35.

Query Column.

RULES.

1. Each correspondent is restricted to *one question.* We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

Arithmetic.

1. SIGMA.—Eight bells begin tolling simultaneously, and they toll at intervals of 1, 2, 3, 4, 5, 6, 7, 8 seconds respectively; find after what interval of time they will again be all tolling at the same instant.—*Barnard Smith.*

L. C. M. of 1, 2, 3, 4, 5, 6, 7, 8 = 840;
∴ they will toll together in 840 seconds = 14 minutes. Ans.

2. NEMO.—The population of 4 cities is in the proportion of the reciprocals of $\frac{1}{3}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$; suppose the last to have had 36,000 inhabitants, what were the populations of the others respectively?

Reciprocals of $\frac{1}{3}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9} = \frac{3}{9}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$
$= \frac{90, 75, 72, 70}{60}$;

Population of first city $= \frac{9}{70}$ of 36,000
$= 46,285\frac{5}{7}$;
,, second ,, $= \frac{7}{70}$ of 36,000
$= 38,571\frac{3}{7}$;
,, third ,, $= \frac{8}{70}$ of 36,000
$= 37,028\frac{4}{7}$. Ans.

3. PHILADELPHIA.—A bankrupt has good debts to the amount of £456 18s. 3d., and the following bad debts, £360 7s. 6d., £120 13s., and £21 4s., for which he receives respectively 4, 5, and 10 shillings in the £; his own liabilities amount to £4,558; how much can he pay in the £?—*Barnard Smith.*

Amount received for 1st bad debt = $\frac{4}{20}$ of £360 7s. 6d.
= £72 1s. 6d.;
,, ,, ,, 2nd ,, ,, = $\frac{5}{20}$ of £120 13s.
= £30 3s. 3d.;
,, ,, ,, 3rd ,, ,, = $\frac{10}{20}$ of £21 4s.
= £10 12s.
Total amount received = £456 18s. 3d. + £72 1s. 6d. + £30 3s. 3d. + £10 12s.
= £569 15s.;
∴ Amount payable in the £ = £569 15s. ÷ 4,558
= 2s. 6d. Ans.

4. *γνῶθι σαυτόν.*—A and B together owe me £96, B and C £119, and A and C £113; what does each one owe me?—*Davidson's Arithmetic.*

2(A, B, and C) owe £96 + £119 + £113 = £328,
∴ A, B, and C owe £328 ÷ 2 = £164;
∴ A owes £164 − £119 = £45,
B ,, £164 − £113 = £51,
C ,, £164 − £ 96 = £68.

Note.—We can recommend the following arithmetics:—Cornwell and Fitch's, Barnard Smith's, Brook Smith's, Hamblin Smith's, Colenso's, Mansford's, etc.

'There' is an expletive (or introductory) adverb: the second 'there' is an adverb of place. The first is redundant. '*There* is a man *there*.'

5. INQUISITIVE.—Divide £13 10s. into two parts so that if one part be divided equally among 20 boys, and the other part be divided equally among 35 men, each man will have *twice* as much as each boy; how much does each boy get?—*Edinburgh University Local Exam.*, 1883.

Man's share = twice boy's share,
∴ 35 men's shares = 70 boys' shares;
∴ Total number of boys' shares = 70 + 20
= 90;
∴ Boy's share = £13 10s. ÷ 90
= 3s. Ans.

6. IGNORAMUS.—A cistern has two pipes, A and B, which singly could fill it in 9 hours and 10 hours respectively. It has also two taps, C and D, which singly could empty it in 12 and 8 hours respectively. Suppose that when the cistern stands half full of water, A and D are turned on for 3 hours; that then B is also turned on for the next 2 hours; that then A and D are turned off, and C is turned on for the next 8 hours; after which all are shut, and the cistern is found to contain 95 gallons more than half its capacity. (1) Find the contents of the cistern. (2) Find also how much per hour the cistern would lose or gain, if all the pipes were set open at once.—*Colenso.*

A can fill the cistern in 9 hours,
B ,, ,, 10 ,, ,
C empty ,, 12 ,, ,
D ,, ,, 8 ,, ;
∴ A can fill in 1 hour $\frac{1}{9}$ of the cistern,
B ,, ,, $\frac{1}{10}$,, ,
C empty ,, $\frac{1}{12}$,, ,
D ,, ,, $\frac{1}{8}$,, ;
Part filled by A in 5 hours = $\frac{1}{9} \times 5 = \frac{5}{9}$,
,, ,, B ,, 10 ,, = $\frac{1}{10} \times 10 = 1$,
,, emptied C ,, 8 ,, = $\frac{1}{12} \times 8 = \frac{2}{3}$,
,, ,, D ,, 5 ,, = $\frac{1}{8} \times 5 = \frac{5}{8}$;
∴ Additional part of contents = $(\frac{5}{9} + 1) - (\frac{2}{3} + \frac{5}{8})$
= $\frac{17}{9} - \frac{31}{24}$
= $\frac{112 - 93}{72}$
= $\frac{19}{72}$;

But this additional part = 95 gals.;
∴ $\frac{19}{72}$ of the cistern will hold 95 gals.,
∴ The cistern will hold $(95 \times \frac{72}{19})$ gals.
= 360 gals. (1)

Part filled in 1 hour when all are open
= $(\frac{1}{9} + \frac{1}{10}) - (\frac{1}{12} + \frac{1}{8})$
= $\frac{19}{90} - \frac{5}{24}$
= $\frac{1}{360}$;

∴ The cistern would gain 1 gallon per hour, if all the pipes were open. (2)

7. R. B. P.—A person went to market and bought 100 animals for £100. He bought oxen at £15, sheep at £1 10s., and rabbits at 2s. 6d. each respectively. How many of each description did he buy?

Difference between price of oxen and average price
= £15 − £1
= £14;
,, ,, sheep ,, = 1 10s. − £1
= 10s.
,, ,, rabbits ,, = £1 − 2s 6d.
= 17s. 6d.;
(For 1st difference), No. of oxen : No. of rabbits
:: 17s. 6d. : £14
:: $\frac{7}{6}$: 14
: 1 : 16;

(For 2nd difference.), No. of sheep : No. of rabbits
:: 17s. 6d. : 10s.
:: $\frac{1}{4}$: $\frac{1}{7}$
:: 7 : 4 ;

For every ox there must be 16 rabbits,
,, 7 sheep ,, 4 ,, ;
For 2 oxen there must be 32 rabbits,
Remainder of animals = 100 − (32 + 2)
= 66 ;

∴ No. of sheep = $\frac{7}{7+4}$ of 66 = $\frac{7}{11}$ of 66 = 42,
,, rabbits = 32 + (66 − 42) = 56.

8. TOM JONES.—At what rate per cent. will £750 amount to £1067 17s. $5\frac{1}{16}$d. in 3 years, compound interest? (*Hughes's Practical Course of Arithmetic.*)

Amount of £1 at end of 3 years = £1067 17s. $5\frac{1}{16}$d.
÷ 750
= £1067·87109375
÷ 750
= £1·423828125 ;
Now, $\sqrt[3]{1\cdot423828125} = 1\cdot125$;
∴ Amount of £1 at end of 1 year = £1·125,
,, £100 ,, ,, = £112·5 ;
∴ Rate per cent = 12½.

Note.—Find the root of the amount of £1, represented by the No. of years.

9. RUPERT.—Five horses start together and continue running round a circular course which is two miles in circumference. If they respectively run at 18, 16, 15, 12, and 10 miles an hour, how soon will they all be again together at the starting point? (*Civil Service Examination, Nov.*, 1881.)

First horse runs a round in $\frac{2}{18}$ hr. = $\frac{1}{9}$ hr.,
Second ,, ,, $\frac{2}{16}$ hr. = $\frac{1}{8}$ hr.,
Third ,, ,, $\frac{2}{15}$ hr.,
Fourth ,, ,, $\frac{2}{12}$ hr. = $\frac{1}{6}$ hr.,
Fifth ,, ,, $\frac{2}{10}$ hr. = $\frac{1}{5}$ hr. ;
$\frac{1}{9}$, $\frac{1}{8}$, $\frac{1}{15}$, $\frac{1}{6}$, $\frac{1}{5}$;
L.C.M. of numerators = 2 ;
∴ They are all again together at the starting point in 2 hrs. Ans.

Note.—Your writing is *very good*, and we believe it will obtain the full amount of marks at the Civil Service Examination.

10. J. EDWARDS.—The 'Times' issued on the morning of January 1st, 1880, was numbered 29,766. Find the No. of the same journal published on the 2nd Saturday in December, 1877. (*Lower Division, Feb.*, 1880.)

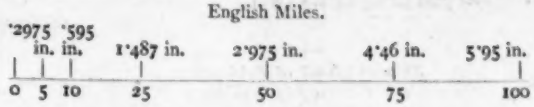
Jan. 1st, 1880, was on Thursday, No. 29,766 ;
,, 1879 ,, Wednesday, No. 29,453 ;
,, 1878 ,, Tuesday, No. 29,140 ;
Monday, Dec. 31st, 1877, No. 29,139 ;
Saturday, ,, 29th, ,, No. 29,138 ;
,, ,, 22nd, ,, No. 29,132 ;
,, ,, 15th, ,, No. 29,126 ;
,, ,, 8th, ,, No. 29,120. Ans.

Note.—*Cornwell's* 'Geography,' 3s. 6d.

11. ALPHA.—Two places on a French map are known to be 17 French leagues apart, and this distance is represented by 2·45 English inches. Draw a scale of English miles for the map showing 100 miles. Show all your calculations, figure the scale properly, and write above it its representative fraction. (1 French league = 4262·84 English yards.)

Distance = (4262·84 × 17) English yds.
= 72,468·28 English yds. ;
yds. yds. in.
∴ 72,468·28 : 176,000 :: 2·45 : Scale for 100 miles
18,117·07 44,000
2·45
9800
9800
18117·07)107800·00(5·95 in....
9058535
17214650
16305563
9092870
9058535
34335

English Miles.



12. M. R. S.—A watch going uniformly is 5 minutes slow at 9 a.m. on May 23rd, and 13·296 minutes fast at 20 past 2 a.m. on June 6th. Find at what instant it was exactly right, and the true time when on May 27th it indicated 45 min. 32½ sec. past noon. (*Excise*, 1882.)

Time from May 23rd 9 a.m. to June 6th 2.20 a.m.
= 13 days 17 hrs. 20 min. ;
Time gained = (13·296 + 5) min.
= $(13\frac{37}{125} + 5)$ min.
= $18\frac{37}{125}$ min. ;
min. min. days. hrs. min.
∴ $18\frac{37}{125}$: 5 :: 13 17 20 : Time to gain 5 min.
27 27 24
494 135 329
60
19760
40
= 5400 min.
= 3 days 18 hrs.

∴ Clock was exactly correct 3 days 18 hrs. after May 23rd 9 a.m.,
that is, May 27th, 3 a.m.

Time from 3 a.m. to 12 − 45 − 32½ p.m.
= 9 hrs. 45 min. 32½ sec. ;
days hrs. min. hrs. min. sec. min.
∴ 3 18 5 : 9 45 32½ :: 5 : Time gained.
24 60
90 585
60 60
1440 35132
1081 2
70265
65
= 32½ sec.
∴ True time = 45 min. past noon.

Note.—(1) Yes. (2) We believe your writing would obtain the full percentage of marks.

13. CERTIFICATE.—A can do a piece of work in 10 days, B in 9, C in 12. They all begin it together, but only C continues till the work is finished, A leaving it 3½ days and B 2½ days before its completion. In what time is it performed?

Part done by all in 1 day = $\frac{1}{10} + \frac{1}{9} + \frac{1}{12}$
= $\frac{18+20+15}{180}$
= $\frac{53}{180}$;
Part A could do in 3½ days = $\frac{1}{10} \times \frac{18}{5}$
= $\frac{9}{5}$;
,, B ,, ,, 2½ ,, = $\frac{1}{9} \times \frac{5}{2}$
= $\frac{5}{18}$;
∴ The work is performed in $\{(1 + \frac{9}{5} + \frac{5}{18}) \div \frac{53}{180}\}$ days
= $\left(\frac{225+81+65}{225} \div \frac{53}{180}\right)$ days
= $\left(\frac{371}{225} \times \frac{180}{53}\right)$ days
= $5\frac{5}{9}$ days. Ans.

14. ROMEO II.—A farm lets for £92 per annum ; the tenant pays for 2 year's occupation, with interest accumulating at 5 per cent. ; the landlord pays ¼ the amount for repairs of house, ⅓ of this for repairs of barn, and £2 3s. 4d. for other expenses ; find the balance. (*Colenso.*)

Amount paid = (£92 × 2) + (5% on £92)
= £184 + £4 12s.
= £188 12s. ;

Part paid for repairs $= \frac{1}{4} + \frac{1}{3}$ of $\frac{1}{8}$
$= \frac{1}{4} + \frac{1}{12}$
$= \frac{1}{3}$;
Amount left $= \frac{2}{3}$ of £188 12s.
$=$ £125 14s. 8d.;
$\therefore$ Balance $=$ £125 14s. 8d. $-$ £2 3s. 4d.
$=$ £123 11s. 4d. Ans.

Algebra.

1. STUDENT.—Solve :—

$$\left.\begin{aligned} x^2+y^2 &= 7+xy \\ x^3+y^3 &= 6xy-1 \end{aligned}\right\}$$

$$\left.\begin{aligned} &(1)\ x^3+y^3 = 7+xy \\ &(2)\ x^3+y^3 = 6xy-1 \end{aligned}\right\}$$

$$\left.\begin{aligned} &(1)\ x^2-xy+y^2 = 7 \\ &(2)\ (x+y)(x^2-xy+y^2) = 6xy-1 \end{aligned}\right\}$$

$$\therefore\ 7(x+y) = 6xy-1$$

$$49(x^2+2xy+y^2) = 36x^2y^2-12xy+1$$

$$\left.\begin{aligned} 49(x^2+y^2) &= 36x^2y^2-110xy+1 \\ (1)\ 49(x^2+y^2) &= 49xy+343 \end{aligned}\right\}$$

$$\therefore\ 36x^2y^2-159xy = 342$$

$$x^2y^2-\tfrac{53}{12}xy = \tfrac{19}{4}$$

$$x^2y^2-\tfrac{53}{12}xy+(\tfrac{53}{24})^2 = \tfrac{19}{4}+\tfrac{2809}{576}$$

$$= \frac{5472+2809}{576}$$

$$= \tfrac{8281}{576}$$

$$xy-\tfrac{53}{24} = \pm\tfrac{91}{24}$$

$$xy = \pm\tfrac{91}{24}+\tfrac{53}{24}$$

$$\therefore\ xy = 6,\ \text{or}\ -\tfrac{19}{12}.$$

$$7(x+y) = 6xy-1$$
$$= 6\times 6-1,\ \text{or}\ (6\times -\tfrac{19}{12})-1$$
$$= 35,\ \text{or}\ -\tfrac{31}{2}$$
$$x+y = 5,\ \text{or}\ -\tfrac{31}{12}$$

$$\left.\begin{aligned} x^2+2xy+y^2 &= 25,\ \text{or}\ \tfrac{961}{144} \\ 4xy &= 24,\ \text{or}\ \tfrac{19}{3} \end{aligned}\right\}$$

$$x^2-2xy+y^2 = 1,\ \tfrac{289}{144},\ -\tfrac{119}{144},\ \text{or}\ \tfrac{361}{144}$$

($\sqrt{\frac{289}{144}}$ and $\sqrt{\frac{361}{144}}$ are surds, and $\sqrt{-\frac{119}{144}}$ is an impossible quantity.)

$$\left.\begin{aligned} \therefore\ x-y &= \pm 1 \\ x+y &= 5 \end{aligned}\right\}$$

$$2x = 6,\ \text{or}\ 4$$
$$\therefore\ x = 3,\ \text{or}\ 2.$$

$$\therefore\ x = 3,\ 2 \text{ and } y = 2,\ 3.$$

2. INQUISITIVE.—Evaluate :—

$$\frac{2(x-y)(1-xy)(x+1)(y+1)}{(x^2+1)(y^2+1)},\ \text{when}$$

$$x = \sqrt{2}-\sqrt{3} \text{ and } y = \sqrt{2}+\sqrt{3}.$$

—(*Edinburgh University*, 1882-3.)

$$\frac{2(x-y)(1-xy)(x+1)(y+1)}{(x^2+1)(y^2+1)}$$

$$= \frac{2(x-y)(1-xy)(x+1)(y+1)}{(x+1)(x^2-x+1)(y+1)(y^2-y+1)}$$

$$= \frac{2(x-y)(1-xy)}{(x^2-x+1)(y^2-y+1)}$$

$$= \frac{2(x-y)(1-xy)}{x^2y^2-xy(x+y)+xy+x^2+y^2-(x+y)+1}$$

Now, $x+y = 2\sqrt{2}$, and $x-y = -2\sqrt{3}$,
$x^2+2xy+y^2 = 8$, and $x^2-2xy+y^2 = 12$,
Hence, $x^2+y^2 = 10$, and $xy = -1$)

$$= \frac{2\times(-2\sqrt{3})\times 2}{1+2\sqrt{2}-1+10-2\sqrt{2}+1}$$

$$= -\frac{8\sqrt{3}}{11}.\ \text{Ans.}$$

3. GAITERS, Lamorna Cove.—Solve :—

$$\sqrt{b^2+ax}-\sqrt{a^2+bx} = a+b. \quad (\textit{Todhunter.})$$

$$\sqrt{b^2+ax}-\sqrt{a^2+bx} = a+b$$

Squaring each side $\Big\}$ $b^2+ax-2\sqrt{(a^2+bx)(b^2+ax)}+a^2+bx = a^2+2ab+b^2$

$$-2\sqrt{a^2b^2+a^3x+b^3x+abx^2} = 2ab-ax-bx$$

Squaring each side $\Big\}$ $4a^2b^2+4a^3x+4b^3x+4abx^2$
$$= 4a^2b^2+a^2x^2+b^2x^2-4a^2bx-4ab^2x+2abx$$

$$a^2x^2-2abx^2+b^2x^2 = 4a^3x+4a^2bx+4ab^2x+4b^3x$$
$$x^2(a-b)^2 = 4x(a^3+a^2b+ab^2+b^3)$$

Dividing each side by x, $x(a-b)^2 = 4(a+b)(a^2+b^2)$

$$\therefore\ x = \frac{4(a+b)(a^2+b^2)}{(a-b)^2}.$$

4. SHERWOOD.—What is the remainder when $(x-1)(x-3)(x-5)(x-7)$ is divided by $(x-2)(x-4)$? (*Edinburgh University*, M.A., 1882.)

$$(x-1)(x-3)(x-5)(x-7)\div(x-2)(x-4)$$
$$= (x^2-4x+3)(x^2-12x+35)\div x^2-6x+8$$
$$= x^4-16x^3+86x^2-176x+105\div x^2-6x+8;$$

	1	−16	+86	−176	+105
6			6	−60	+108
−8				−8	+80	−144
	1	−10	+18	+12	−39

$\therefore$ Quotient $= x^2-10x+18$ and

Remainder $= 12x-39.$

5. EUCLID.—Find the conditions that the two cubics

$$\left.\begin{aligned} ax^3+bx^2+cx+d &= 0 \\ a'x^3+b'x^2+c'x+d' &= 0 \end{aligned}\right\}$$

should have two common roots. (*Dublin University*, 1882.)

$$\left.\begin{aligned} ax^3+bx^2+cx+d &= 0 \\ a'x^3+b'x^2+c'x+a' &= 0 \end{aligned}\right\}$$

$$\left.\begin{aligned} aa'x^3+a'bx^2+a'cx+a'd &= 0 \\ aa'x^3+ab'x^2+ac'x+aa' &= 0 \end{aligned}\right\}$$

$$(ab'-a'b)x^2+(ac'-a'c)x+(ad'-a'd) = 0$$

$$x^2+\frac{ac'-a'c}{ab'-a'b}x = \frac{a'd-ad'}{ab'-a'b}$$

$$x^2+\frac{ac'-a'c}{ab'-a'b}x+\left\{\frac{ac'-a'c}{2(ab'-a'b)}\right\}^2 = \frac{a'd-ad'}{ab'-a'b}$$
$$+\frac{a^2c'^2-2aa'cc'+a'^2c^2}{4(ab'-a'b)^2}$$

$$= \frac{4(ab'-a'b)(a'd-ad')+a^2c'^2-2aa'cc'+a'^2c^2}{4(ab'-a'b)^2}$$

$$= \frac{4aa'b'd-4a^2b'd'-4a'^2bd+4aabd'+a^2c'^2}{-2aa'cc'+a'^2c^2}$$
$$4(ab'-a'b)^2$$

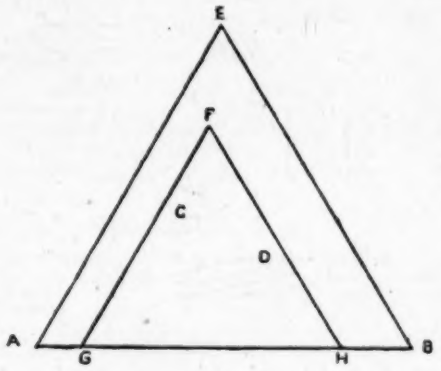
$$= \frac{a^2(c'^2-4b'a')-2aa'(cc'-2bd'-2b'd)}{+a'^2(c^2-4bd)}$$
$$4(ab'-a'b)^2;$$

$\therefore$ Condition is :—

$\sqrt{(c^2-4bd)(c'^2-4b'd')}$ must equal $(cc'-2bd'-2b'd)$.

Geometry.

1. TRURON.—Through two given points on the same side of a given straight line draw two other straight lines, so as to meet the given straight line and form with it an equilateral triangle.



Let AB be the given straight line, and C, D the two given points.

Upon AB describe the equilateral triangle ABE. (I. 1.)

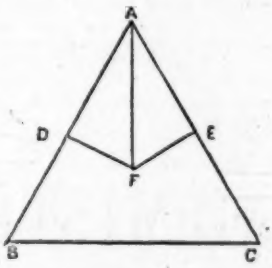
Through C draw GC parallel to AE, and through D draw HD parallel to BE. (I. 31.)

Produce GC and HD to meet at F. Then, FGH is the equilateral triangle required.

Proof.—$\angle FGH = \angle EAB$, (I. 29.)
$\angle FHG = \angle EBA$. ,,
$\therefore \angle GFH = \angle AEB$; (I. 32.)
But, $\triangle EAB$ is equiangular.
$\therefore \triangle FGH$ is equiangular, and therefore equilateral. (I. 6. Cor.) Q. E. F.

Note.—The plural form is correct.

2. INCOGNITO.—The square on the side of an equilateral triangle is equal to three times the square on the radius of the circle which passes through its angular points.



Let ABC be an equilateral triangle.

Bisect AB and AC in D and E. (I. 10.)

At D and E draw the perpendiculars DF and EF, meeting in F. (I. 11.)

Join AF. Then AF is the radius of the circle which passes through A, B, C.

Proof.—$AF^2 = AD^2 + DF^2$, (I. 47.)
Also, $AF^2 = AE^2 + EF^2$;
and $AD = AE$, $\therefore DF = EF$;

In the triangle ADF, AEF, the two sides DA, AF = the two sides EA, AF, and the base DF = the base EF.

$\therefore \angle DAF = \angle EAF$; (I. 8.)
$\angle CAB = \frac{1}{3}$ right angle, being the angle of an equilateral triangle,
$\therefore \angle DAF = \frac{1}{6}$ right angle,
and $\angle AFD = \frac{1}{3}$ right angle; (I. 32.)
$\therefore \triangle ADF$ is half an equilateral triangle, of which the side is AF,

$\therefore$ FD = ½ side of the triangle
= ½AF.
$AF^2 = AD^2 + DF^2$, (I. 47.)
$= AD^2 + (\frac{1}{2}AF)^2$
$= AD^2 + \frac{1}{4}AF^2$
$\frac{3}{4}AF^2 = AD^2$
$3AF^2 = 4AD^2$
$= \underline{AB^2}$, as AD is half of AB.

Q. E. D.

General.

1. RALPHO'S writing is good; its stiffness will disappear by practice. Botany, we repeat, is one of the twelve 'additional subjects' for which marks will be given at the Admission Examination in July.

2. EDINBURGH.—In all the cases quoted, *ours* (*our's*), *theirs* (*their's*), *its*, *mine*, *thine*, *his*, *hers*, are pronominal adjectives or possessive pronouns, which are used without the noun to which they relate. *Its* is not now used in this way. 'Its are black' (*i.e.*, the *Timbuctoo* people) is not elegant. The apostrophe is similarly obsolete in *our's*, *their's*. *Both* (once an adjective of number meaning two) is used as a conjunction.

3. ROGO.—(1) You *must* have copied your query *incorrectly*; please repeat it.

4. HERBERT.—Your query was solved in our issue for July 1882.

5. ODIN.—The solution of your query appeared in our issue for June, 1882.

6. R. M. S.—You will find the solution of your query in our issue for December, 1882.

5^3 means the third power or cube of 5;
5^5 ,, ,, fifth ,, of 5; etc.

7. DISCIPULUS.—Your query appears in our issue for March 1882.

8. JULIUS CÆSAR.—In your query you do not state how long A and B live, and therefore it is impossible to give how much more waking life B will have than A.

9. M.—Thanks for your solution.

10. Q. R. S. writes well. His studies should give him a good place on the list, but he should practise the expression of his acquired knowledge. Composition is of great importance. Let him begin Latin by all means. He is not likely to excel without it. He can take French afterwards.

11. IN DOUBT.—'Pretty Fair' is of less value than 'Fair,' and 'Very Fair' is next to 'Good,' usually, in the scale of marks. The value of bullion varies.

12. NANCY.—The statement to which you refer is inaccurate, and was inserted by oversight. It was corrected in the *July* number of the PRACTICAL TEACHER, and should read as follows:—'*Six perfect* fourths, each comprising two major seconds and one minor second, or *five* semitones.'

13. BLACKBURNIAN.—He were no lion were not Romans hinds. The first *were* = would be; the second *were* is subjunctive: if the Romans *were* not hinds.

14. AMICUS will notice many words which, though they begin with an aspirate, are preceded by *an* when the accent is not on the first syllable. *A har'mony*, but *an harmon'ic*. Hence we say *an hotel*, the aspirate in such cases not being marked.

15. J. AMESBURY.—No French author is prescribed for the July examination. Learn well the verbs.

16. J. H. R.—63. Finer rhythm for *Taa Taatai* = *Tuatefe*
A Broader = *Taa-aa Taa Taa*.
64. Finer rhythm for Taa-aatai = Taa-efe.
Broader ditto = *Taa-aa-aa Taa*.

17. M. L. R.—The Certificate Examination Questions are annually published in our columns, and in older journals like *The Schoolmaster* and *School Guardian*. We have given some answers. No book containing complete sets is known to us.

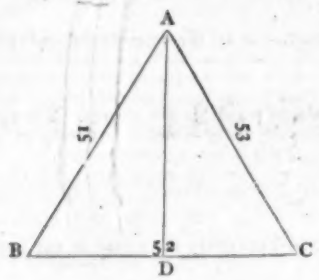
18. IXION OF SEGONTIUM.—Your query is simply a test of patience.

19. FOURTH YEAR P.T.—The answer is given in the second staff, p. 348. Any work on harmony will give a full explanation.

20. J. F. A.—*Tanner's* 'Advanced Course of Agriculture' (Macmillan).

Mensuration.

1. YELSSERP.—The sides of a triangle are 51, 52, and 53 ft.; find the perpendicular from the opposite angle on the side of 52 ft., and find the area of the two triangles into which the original triangle is thus divided. (*Todhunter.*)



$AD^2 = AC^2 - CD^2$, (I. 47.)
$= AB^2 - BD^2$;
$\therefore AC^2 - CD^2 = AB^2 - BD^2$, (Ax. 1.)
$53^2 - (52 - BD)^2 = 51^2 - BD^2$
$2809 - (2704 - 104\,BD + BD^2) = 2601 - BD^2$
$2809 - 2704 + 104\,BD - BD^2 = 2601 - BD^2$
$105 + 104\,BD = 2601$
$104\,BD = 2601 - 145$
$= 2496$
$\therefore BD = 24.$
$AD^2 = AB^2 - BD^2$
$= 51^2 - 24^2$
$= 2601 - 576$
$= 2025$
$\therefore AD = \sqrt{2025}$
$= 45.$

$\therefore$ Length of the perpendicular $= 45$ feet.

Area of triangle $ABD = \frac{1}{2}(BD \times AD)$
$= \frac{1}{2}(24 \times 45)$ sq. ft.
$= 540$ sq. ft.;

" " $ACD = \frac{1}{2}(CD \times AD)$
$= \frac{1}{2}(28 \times 45)$ sq. ft.
$= 630$ sq. ft.

Note.—'Algebra' (*Todhunter*); 'Euclid' (*Todhunter*, *Potts*, or *Hamblin Smith*); 'Trigonometry' (*Todhunter*); 'Conic Sections' (*Drew* and *Todhunter*), etc.

2. X. Y. Z.—A drawing-room 36 ft. 10 in. long, and 23 ft. 2 in. wide, is surrounded with a cornice $3\frac{1}{2}$ in. wide, the gilding of which cost £4 11s. $10\frac{1}{2}$d.; how much was that per square foot?

Perimeter of room $= (36$ ft. 10 in. $+ 23$ ft. 2 in.$) \times 2$
$= 60$ ft. $\times 2$
$= 120$ ft.;
Area of cornice $= 120$ ft. $\times 3\frac{1}{2}$ in.
$= \frac{120 \times 7}{24}$ sq. ft.
$= 35$ sq. ft.;
$\therefore$ Cost per square foot $=$ £4 11s. $10\frac{1}{2}$d. $\div 35$
$=$ 2s. $7\frac{1}{2}$d. Ans.

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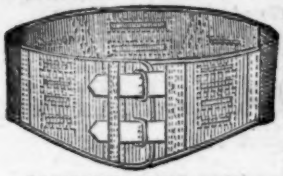

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